

When the team clicks:
The social cognition of joint action
among professional Chinese rugby
players



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A thesis submitted for
Doctor of Philosophy
Trinity 2018

Acknowledgements

This research would not have been possible without the warm welcome I have received from the Chinese rugby community for the past 12 years. For assistance with research and access to participants, I would like to thank the Chinese Rugby Football Association, Beijing Temple of God of Agriculture Sports Institute, and the Shandong Sports Institute (Weihai). I would like to thank Zhu Peihou, Wang Chongyi, and Lu Xiaohui for supporting my research. Liu Kai, Zhao Zhao, and Du Ziyuan—thanks for being my friends and guardians in China. 中国橄榄球加油！

To my supervisor, Emma Cohen, thank you for going above and beyond for me, and for both supporting my curiosity and teaching me the importance of healthy scientific skepticism. To Bronwyn Tarr, thank you for stepping in, and for all your time and effort on my behalf. To all at ICEA, thank you. Cole, Bahar, Megan, Adam, Hristo, Dan, and Kat. Arran Davis—you are a true companion and I cherish our connection.

I am very grateful for the intellectual inspiration and support I have drawn from colleagues and friends. Thank you in particular to Peter Drysdale, Sebastien Lerique, Graeme MacGilchrist, Michael Richardson, and Will Zou for providing formal support and informal guidance. To Lewis Anderson, Charlotte Baarda, Alex Baron, Hugo Batten, Helen Baxendale, Rachel Benoit, Jenny Bright, John Carter, Louis Chambers, Tom Davis, Andrew Dean, Ed Doe, Sam Egerton, Nick Gardner, Julian Gewirtz, Dan Guinness, Ben Hall, Fraser Heathcote, Jonathan Hudson, Ben Hunn, Matt Janney, Camilla Bjarnoe Jensen, Gus Jones, Tomek Juszczuk, Mie Kayser, Henry Lamont, Zandy MacDonald, Ryan Manuel, Wande McCunn, Tim McGinnis, George Messum, Yale Michaels, Sean Morris, Tara O'Sullivan, Mark Pavli, James Pennington, Tom Reeson-Price, Mandy Rojek, Moizza Sarwar, Mubeen Shakir, Freya Shearer, Aaron Spencer, Tim Stevens, Katie Stone, Fergus Taylor, Starr Thibodo-Carter, James Wade, Ralph Weir, Ben Wilcox, and many more—thank you.

To my examiners, Susana Carvalho and Natalie Sebanz, thank you for your helpful comments and feedback on this research, as well as valuable ideas for future development of the social cognition of team click. I am indebted to the Rhodes Trust, Keble College, St John's College, and the East Asia Bureau of Economic Research at the Australian National University for funding and support. Thank you Charles, Mary, Sheila, Bob, Dawn, and John at Rhodes House. Thank you

Annabel McGoldrick for helping navigate through the DPhil swamp and come out with a more honest understanding of myself. Thank you also Mariella De Martini for helping me maintain a bodily practice and spiritual light-heartedness.

Mostly, I feel deep gratitude for my family: Julia, John, and Sandy. Thanks Mum for guiding me through the madness of the final push. Above all, thank you Nina for your love, support, and last minute latex tables.

Abstract

Humans display an unmistakable tendency to come together and move together. Amidst all of the scientific questions that we ask of ourselves, how and why we move together are two fundamental questions that have evaded detailed and rigorous consideration, until recently. The key assertion of this thesis is that a scientific explanation for the prevalence of physiologically exertive and socially coordinated movement (group exercise) in human sociality can benefit from closer attention to the mechanisms of joint action (defined herein as the dynamic coordination of behaviour between two or more co-actors). I propose novel theoretical synthesis and conduct focussed empirical research to explore and substantiate this assertion.

This thesis tests the hypothesis that the phenomenon of “team click” mediates a relationship between joint action and social bonding in group exercise contexts. Team click refers to a visceral and agentic experience of optimal performance in joint action. Although anecdotal evidence is pervasive, theory-driven investigation into the phenomenon is lacking. I develop a theoretical grounding for team click based on the proposed relationship between dynamical coordination of physical movement and social communication, as a response to cognitive uncertainty of joint action. I formulate a novel general theoretical account of team click in group exercise, which I test with ethnographic, survey, and field experimental data collected with a population of professional rugby players in China. Results generally support the prediction that more positive perceptions of successful team performance in joint action leads to higher levels of social bonding in group exercise, mediated by higher levels of team click. Results also suggest that positive violation of expectations surrounding team performance may play an important role as a precedent for team click in complex and uncertain joint action scenarios. From these results, I infer that team click establishes a physically embodied, and socially embedded cognitive foundation conducive to more elaborate and culturally contingent processes characteristic of social bonding. Further empirical research is warranted to more precisely isolate and operationalise causal mechanisms that generate team click and social bonding in joint action scenarios typical of group exercise.

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List of Abbreviations

MES		Modern Evolutionary Synthesis
CR		Cognitive Revolution
AIF		Active Inference Framework
PC		Predictive Coding
FIS		Functional Interpersonal Synergies
CAU		Chinese Agricultural University
CRFA		Chinese Rugby Football Association

I do not see any way to avoid the problem of coordination and still understand the physical basis of life.

— H. H. Pattee *The role of instabilities in the evolution of control hierarchies* 1976

1

Introduction

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1.1 Group exercise as carnal mystery

On the first night that I arrived in Beijing for research in August 2015, Adrian, Kai, and I sat in the upstairs area of the Korean BBQ restaurant in a quiet willow lined street just inside Beijing’s East 4th Ring Road. Adrian was the host of the

dinner, and so he naturally held the floor in conversation while the three of us waited for his colleague Mr Shi to arrive.¹

Adrian was a veritable elder of Chinese rugby union (hereafter simply rugby). He had been captain of the second class of rugby players to graduate from the Chinese Agricultural University (CAU), the home of China's first official rugby union program, established in 1990. Kai—also a CAU graduate (2007)—was a close friend of mine of many years, and had invited me to join at the dinner soon after I touched down earlier that day. I was eager to catch up with old friends as well as begin my fieldwork, and so, despite my jet lag, I accepted the invitation.

Adrian reminisced fondly about his time playing rugby at CAU, as well as his time after graduation playing with the Beijing Devils, a rugby club in Beijing whose members were predominantly expats. He assured us that rugby in China was, in those days, fun and free-spirited. Not like today, now that rugby has become a professional program in the state-sponsored sport system. Adrian talked about going on a rugby tour to the UK with the Beijing Devils: “Everyone only just scraped together the money to go on tour. We all paid our own way. Sometimes you'd get a bit of help from someone or whatever. We did it because we loved the game, not for any other reason.” Kai and I listened intently. All of a sudden I realised that this conversation could be relevant, so I started taking notes.

When Mr Shi finally arrived, Adrian continued in his nostalgic mode, but naturally shifted his target audience from Kai and me to his guest. Adrian began to describe in rich detail the experience of camaraderie between his Beijing Devils team mates when they participated in a overseas rugby tours. At one point Adrian interrupted his own story to make an explanatory aside directed at Mr Shi, accommodating for the fact that Mr Shi was relatively unacquainted with the sport: “This sport, rugby: it's actually very mysterious. If you haven't played it yourself you might not know this type of feeling,” (英式橄榄球这个项目其实特别神秘, 没玩过的话您可能不知道这种感觉) Adrian respectfully suggested to Mr Shi. “Because rugby, you know, you're all on the field together, there's body contact...”

¹I use real names for participants unless otherwise stated.

(因为英式橄榄球么，大家在场上有身体接触) he paused to find the right phrasing, “It’s a very *carnal* type of feeling” (是一种“肉”的感觉). His attempts to enrich his communication by gesticulating had led him to have both of his hands clenched as fists in front of him like they were cradling a rugby ball or gripping the steering wheel of a car—a lit cigarette smouldering between the index and middle finger of his right hand. Adrian concluded by looking into the distance and repeating: “Its very mysterious.” (特别神秘) He shook his head as if baffled and finally released his clenched fists to dab the ash from his cigarette into the ashtray in front of him. After taking another drag from his cigarette he finally added: “So it means this rugby circle here in China is very tight...” (所以在橄榄球这个圈子特别亲)—a short pause for another dab of his cigarette— “...but it doesn’t mean that this circle is not also complete chaos!” (但这不是说这个圈儿也不乱!)² The wisdom of Adrians’s final punchline was confirmed with a knowing chuckle from all of us, including Mr Shi. Adrian concluded his performance silently, by taking a long, satisfying drag of his cigarette and looking off into the most distant corner of the restaurant.

I was captivated—but also somewhat surprised—by Adrian’s monologue. I was not expecting, so early into my fieldwork, to happen upon a declaration in which a link between the carnal (*rou* 肉) or visceral sensations associated with on-field joint action, and social processes of interpersonal affiliation (*qin* 亲) and group cohesion of the rugby community (*quanzi* 圈子) was so explicitly and spontaneously emphasised. It was clear that rugby’s visceral dimension continued to capture Adrian emotionally; some 10 years after he had finished playing rugby his fists still clenched with energy, and his head still shook with amazement.

I was also intrigued that Adrian cited the source of his emotional capture as at once both very specific (derived from playing together with others on the field) and, at the same time, ultimately “mysterious.” The aim of my research was to contribute to an explanation the human behavioural phenomenon of group exercise in terms of its social, evolutionary, cognitive, and physiological causal processes and dynamics. In essence, the aim is to somehow move from mystery to scientific

²Circle (*quanzi* 圈子) is a common colloquial way to refer to a social group or community of people in modern standard Chinese.

mechanism. At this first dinner in Beijing, Adrian’s comments both captured the phenomenological mystery of group exercise, and pointed me in the direction of the underlying explanatory mechanisms.

Needless to say, I left that first dinner eager to investigate the sources of Adrian’s experience of mysterious carnality and social connection in rugby’s joint action. My next stop, on the following Monday morning, was the Temple of God of Agriculture Sports Institute, where I began ethnographic research with the Beijing Provincial rugby program.

1.2 Group exercise as evolutionary puzzle

Competitive team sports, whirling Sufi dervishes, late-night electronic music raves, Masi ceremonial dances, or the fitness cults of Cross-fit and Soul Cycle—endless examples can be plucked from across cultures and throughout time to exemplify the human compulsion to come together and move together. How can we explain the prevalence of these activities in the human record? In this thesis, I contribute to a scientific understanding of “group exercise”—defined herein as physiologically exertive and socially coordinated movement—by way of a focussed study of the social cognition of joint action among professional Chinese rugby players.

Because physical movement is a metabolically expensive task, it is justifiable from an evolutionary standpoint only if the benefits somehow outweigh the costs. Using this basic calculus, it is easy to imagine how group exercise would have served important survival functions in our ancestral past. Activities involving group exercise such as hunting, travel, communication, and defence all appear to confer immediate and obvious benefits to individuals and groups (Sands & Sands, 2010).

In more recent domains of human history, however, the task of explaining the persistent recurrence of group exercise is more complicated. At least since the late Pleistocene era (approx.500ka), and particularly since the Holocene transition

from hunter-gatherer to agricultural (approx. 11ka), and later industrial and post-industrial societies, group exercise can be identified in shared cultural practices as varied as religion, organised warfare, music, dance, play, and sport. But unlike group hunting or defence, the fitness-relevant benefits of group exercise in cultural practices such as sport, music, or dance are not always as obvious. On the contrary, many of these activities appear on the face of it to entail extreme time and energy costs for very little immediate reward.

Thus, the prevalence of group exercise in a diverse array of shared cultural practices in the more recent human record presents an evolutionary puzzle. A solution to this puzzle requires a more nuanced calculus that incorporates an appreciation of humans' species-unique evolutionary trajectory, defined by increasingly complex cognitive and cultural capacities, including technical manipulation of extra-somatic materials and ecologies; advanced theory of mind; and information-rich, malleable, and scalable communication systems (Roepstorff, Niewöhner, & Beck, 2010; Clark, 2015a; Fuentes, 2016). A theory capable of satisfactorily explaining group exercise within humans' distinctive evolutionary parameters is yet to be fully formulated (Cohen, 2017).

As Adrian's monologue demonstrates, the experience of group exercise appears to be at once a physical and social phenomenon. The fact that these dimensions somehow coalesce in experiences of group exercise suggests that cultural activities in which group exercise features may have played an important role in human-specific processes of social cohesion (Dunbar & Shultz, 2010; Whitehouse, 2004; Cohen, 2017). In this thesis, I advance existing cognitive and evolutionary understandings of group exercise by formulating and testing a novel theoretical relationship between group exercise and the glue of group cohesion: social bonding.

Existing theories of group exercise and social bonding do not yet satisfactorily account for the variation in, and complexity of, interpersonal movement coordination common to many real-world settings of group exercise. I concentrate in particular on the proximate cognitive mechanisms of "joint action," defined herein as any form of social interaction whereby two or more individuals coordinate their actions in

space and time to bring about a change in the environment (Sebanz, Bekkering, & Knoblich, 2006). I draw attention to the bio-psycho-social effects known to occur when active, in-the-moment, and on-line joint action functions successfully—i.e., when joint action “clicks” between co-actors. I propose the phenomenon of “team click” as a concept that captures the phenomenology of optimal performance in dynamic joint action. More importantly, I propose team click as a psychological construct that can help explain a hitherto under-appreciated causal pathway between uncertainty of joint action and social bonding. Team click offers a vehicle through which the various dynamical interlocking dimensions of experience in group exercise can be analysed in terms of their cognitive and evolutionary significance.

In the chapters that follow, I formulate and test a general account of team click in group exercise, which I situate and test in the group exercise context of rugby in China. I conduct a series of three empirical studies with professional Chinese rugby players. These studies include 1) an ethnographic study of the Beijing men’s rugby team (Chapters 4 and 5), 2) an *in situ* survey study of professional Chinese rugby players during a National rugby tournament (Chapter 6), and 3) a controlled field experiment with a sample of professional Chinese rugby players recruited from two of China’s provincial rugby programs (Chapter 7). In each of these studies I find evidence to support the research hypotheses and specific predictions of this thesis. Specifically, more positive perceptions of success in team performance predict higher levels of team click; higher levels of team click predict higher levels of social bonding, and, in some instances, team click mediates—either fully or partially—a direct positive relationship between perceptions of success in team performance and social bonding.

This thesis progresses in a step-wise manner: I start with broad and rich ethnographic observation and analysis, and build on these observations towards a more quantitative verification of hypothesised mechanisms. Findings from each study offer initial substantiation of a general account of team click in group exercise.

In what remains of this chapter, I review existing theories of group exercise and social cohesion (Section 1.3), and point to empirical and theoretical knowledge gaps

that require attention (Section 1.4). In particular, I identify the under-theorised relationship between successful performance in complex joint action and perceptions of team click. I conclude by previewing a general account of team click and the main empirical components of this thesis.

1.3 Existing scientific explanations of group exercise

In this section I outline existing cognitive and evolutionary accounts of group exercise. In this thesis, I define group exercise broadly as any activity that minimally entails 1) sustained physical exercise (i.e., structured physical activity that reaches at least low intensity physiological exertion of 45% of max heart rate or above; see Caspersen, Powell, & Christenson, 1985), and 2) coordination of behaviour between two or more individuals in time and space to bring about change in the environment (a.k.a., joint action, see Sebanz et al., 2006; Vesper, Butterfill, Knoblich, & Sebanz, 2010). A broad definition of this nature allows for the identification of instances of group exercise in a wide array of contexts throughout the human record, from music making and dance, to ritual practices, to competitive sport, warfare, play, and even pair-bonding activities such as sexual intercourse. Anecdotal and ethnographic evidence pertaining to humans' subjective experience of all of these activities suggests that group exercise commonly entails a prominent and unmistakable visceral dimension. But, as I explain below, the natural scientific origins of this dimension of experience have remained unclear.

1.3.1 Evolutionary origins of group exercise

Archeological and primatological evidence suggests that human's capacity for group exercise runs deep into our evolutionary trajectory. Humans have evolved distinct morphological and physiological adaptations that enable sustained aerobic exercise. Adaptations include derived skeletal features that support stable bipedal running and respiratory function (see Bramble & Lieberman, 2004), as well as exercise-specific neurobiological reward (Raichlen, Foster, Gerdeman, Seillier, & Giuffrida,

2012). The archeological record indicates that a capacity for sustained physical exercise may have emerged at some point during or after the divergence between Pan (i.e., *Australopithecus*) to *Homo*, and could be associated with activities such as persistence hunting, defence of territory, and communication over vast distances such as those conceivable in woodland or grassland savanna, as opposed to dense canopy rainforests of pre-human ancestors (Sands & Sands, 2012).³

The co-occurrence of physical exertion with joint action has been identified in activities of non-human primates, suggesting that the human propensity for group exercise scaffolds on top of strong evolutionary foundations laid well before our last common ancestor with Chimpanzees ($\sim 5 - 7$ mya). Group hunting in Chimpanzees is by now well-documented and is known to be both spontaneous, highly organised (for example involving divisions of set roles; see Boesch & Boesch, 1989), and causally linked to social bonding (Mitani & Watts, 2001). Chimpanzees behave similarly in group territorial “warfare” against members of neighbouring groups (Boehm, 1992; Wilson et al., 2014). In addition to group hunting and territorial conflicts, Chimpanzees also engage in exertive group activities such as group laughter (Waller & Dunbar, 2005), or coordinated display patterns of tree buttress drumming, pant-hooting, and branch-dragging (for example, observed as part of a “rain dance,” see Goodall, 2000; Whiten et al., 2001). Meanwhile, bonobos display a propensity for highly arousing and energetic socio-sexual encounters, which are hypothesised to quell intra- and inter-group tensions (relating to competition over food or reproductive resources) through the activation of neuropharmacological reward mechanisms (Dunbar, 1992; Parr, Waller, & Fugate, 2005; Clay & De Waal, 2015). Taken together, this evidence suggests that group exercise underpins various

³While all species of the *Homo* genus (*Sapiens*, *Erectus*, and *Habilis*) appear to show evidence of morphological adaptation for running, none of these species appear to be natural sprinters. Even elite human sprinters (capable of sustaining maximum speeds of only 10.2 meters per second for less than 15 seconds) are slow compared to mammalian cursorial specialists such as horses, greyhounds and antelopes, who can maintain maximum galloping speeds of 15–20 meters per second for several minutes (Garland, 1983). Moreover, running is more costly for humans than for most mammals, demanding roughly twice as much metabolic energy per distance travelled than is typical for a mammal of equal body mass (Taylor & Heglund, 1982). This suggests that humans have evolved capacities suited specifically to endurance running at moderate intensities, rather than short bouts of high intensity sprinting (Bramble & Lieberman, 2004).

adaptive social behaviours in non-human primates, ranging from hunting, to group defence, and even social affiliation and diplomacy.

1.3.2 Group exercise as the object of social scientific analysis

Social scientists and anthropologists have long speculated that cultural activities in which group exercise features are somehow central to the function of human sociality. Sociologist Emile Durkheim emphasised the emotional importance of shared ritual practice, which he thought could “change the conditions of psychic activity” (p. 469). This group-level property of “collective effervescence,” Durkheim argues, “strengthen[s] the bonds attaching the individual to the society” and has important behavioural consequences relating to prosociality and well-being (Durkheim 1915/1965; pp. 257-258). “Once the individuals are gathered together,” Durkheim notes of an indigenous Australian tribe engaged in ritual dance, “a sort of electricity is generated from their closeness and quickly launches them to an extraordinary height of exaltation...” As a complement to his more famous essay on the role of shared cultural practices in generating ties of social reciprocity—“The Gift”—Marcel Mauss (Durkheim’s nephew) also drew attention to the importance of the visceral, embodied dimension to human social life in his 1935 essay “Techniques of the Body” (Mauss, 1935).⁴ Meanwhile, anthropologist Victor Turner highlighted the drama of ritual performance (invariably involving group exercise) in creating a playful and liminal space separate from the usual structure of everyday social life in which “spontaneous communitas” and “humankindness” between ritual participants is fostered (Turner, 1974). These accounts share a common focus on the relationship between embodied psychophysiological processes and social processes.

While initial anthropological accounts of group exercise in human sociality lacked an a rigorous scientific framework through which explanatory mechanisms could be

⁴The intuition that the body is at the centre of social processes has been developed throughout an entire French social scientific lineage. Mauss was Durkheim’s nephew, and phenomenologist Maurice Merleau-Ponty (Merleau-Ponty & Bannan, 1956), in turn was influenced by Mauss. Anthropologist Pierre Bourdieu (Bourdieu, 1990), and contemporary sociologist Loic Wacquant (Wacquant, 2004) are also direct descendants of this line of inquiry, which invariably fixates on the causal relevance of “embodied practice” to social phenomena.

tested and verified, the importance of the visceral and emotional dimensions of group exercise to human sociality was nonetheless intuitively grasped and duly emphasised.

1.3.3 The sidelining of group exercise through the modern evolutionary synthesis and the cognitive revolution

Generally speaking, more testable scientific accounts of human behaviour have emerged only in the last ~ 70 years, enabled by 1) the gradual refinement of evolutionary theory, now known as the “modern evolutionary synthesis” (hereafter MES) and 2) the “cognitive revolution” (hereafter CR) of the 1950s and 60s (Laland, Odling-Smee, & Myles, 2010). The MES amounts to a unification of the theory of evolution by natural selection (attributed to Darwin and Wallace in the second half of the 19th century) with a theory of genetic inheritance (replacing a previously popular theory of blended inheritance, see Calcott & Sterenly, 2013). The MES thus paved the way for a “gene-centred” understanding of biological evolution, as changes in the frequency of heritable DNA sequences in a population due to selection pressures exerted at the level of the phenotype (Grafen, 1984). Meanwhile, concepts from information theory, cybernetics, and computation provided the necessary language to describe cognition and evolution as variational, digital, and sequential processes of change (Yockey, 2005). Forefront to initial applications of cognitive and evolutionary approaches to human behaviour were questions of the biological origins of human sociality, including our species-unique capacities (e.g., language and culture) for complex patterns of cooperation and coordination (Wilson, 1975; Chomsky, 1965).

Together, MES and CR enabled anthropologists to draw upon empirical findings and theoretical frameworks from neighbouring fields of cognitive science, psychology, evolutionary biology, and behavioural ecology, to develop hypotheses concerning proximate psychological and cultural causes of, and ultimate (evolutionary) explanations for human sociality (e.g. Dawkins, 1976; Wilson, 1978; Sperber, 1996; Whitehouse, 2004; Dunbar, 1996). However, the necessarily rudimentary parameters of initial MES models of human cognition and evolution also limited the extent

to which these models could account for a full spectrum of behaviour observable in humans' evolutionary niche.

In essence, the theoretical assumptions of MES models have served to direct attention of empirical research towards cognitive mechanisms that are fixed by processes of natural selection (Lickliter & Honeycutt, 2003; Kenrick, 2001). The gene-centred orthodoxy of the MES posits two interrelated assumptions. The first is that population-level distribution of gene frequencies is determined solely by natural selection (including associated stochastic mechanisms of mutation, and genetic drift Grafen, 1991). The second assumption follows from the first, by suggesting that an organism's developmental processes are not causally relevant to evolutionary change (also known as the "phenotypic gambit"; see Grafen, 1984). Assuming that developmental processes are not passed on in the germ-line, immediate processes that contribute to the development of an observable behaviour can be largely set to one side, and instead focus can be placed on the adaptive value of a trait and its phylogenetic history (Mayr, 1961; Dunbar, 1996).

While these assumptions were arguably necessary in order to reduce the overwhelming complexity of biological processes and make scientific analysis of human behaviour tractable (Mayr, 1961), they have also served to direct scientific attention towards a limited subset of cognitive mechanisms. The primary vehicle of MES approaches to human behaviour has been the principle of inclusive fitness. Working within the MES assumptions outlined above, Hamilton (1964) demonstrated that the adaptive value of an observable behavioural trait can be calculated as the sum of direct and indirect fitness benefits to an organism over its lifespan (Grafen, 2006). Inclusive fitness therefore helps explain how social behaviours that appear seemingly costly to the individual phenotype could be *indirectly* beneficial in the case that such behaviours increased the reproductive success of other individuals carrying the same gene (expressed famously in Hamilton's rule of $rb > c$). Considered from the point of view of inclusive fitness, cognition, social learning, and (cultural) communication systems (among other aspects of the human evolutionary niche) are understood

as (adaptive) extensions of the phenotype, which have evolved according to their contribution to the inclusive fitness of the organism over evolutionary time.⁵

In response to this line of MES reasoning, researchers began to hypothesise the existence of evolved cognitive mechanisms that either 1) function according to their contribution to inclusive fitness (an approach that has since matured into the field of evolutionary psychology Cosmides & Tooby, 1992), or else 2) are conducive to the effective (i.e. “cumulative” see Tomasello, Kruger, & Ratner, 1993) transmission of (adaptive) cultural variants (an approach that has since matured into the field of cultural evolution; see Cavalli-Sforza & Feldman, 1981; Boyd & Richerson, 1988). As such, cognitive mechanisms pertaining to aspects of social decision making (in the case of game-theoretical models of cooperation, see Cosmides, 1989; West, El Mouden, & Gardner, 2011) or memory and social learning (in the case of gene-culture coevolutionary models Henrich & McElreath, 2003) have been most actively examined for evidence of their ultimate evolutionary significance (Badcock, 2012). Focus on these cognitive mechanisms and evolutionary processes was further assisted by the furnishing of MES with a theory of change advanced by the CR, which conceived of species-unique aspects of human cognition as primarily logical, grammatical, or symbolic processes of digital (and a-modal) information transfer.⁶ In brief, the assumptions deployed by gene-centred approaches to human evolution indirectly constrain empirical attention to a subset of cognitive mechanisms that contribute to inclusive fitness—either directly by producing adaptive traits, or via successful transmission of cultural variants. Meanwhile, the visceral or embodied dimensions of human experience have been traditionally sidelined as largely inconsequential to a gene-centred MES and an amodal theory of informational change.

⁵Evolutionary biologist Richard Dawkins, for example, famously proposed that human culture should be understood as a digital, variational, and heritable evolutionary system in its own right that furnishes humans’ “extended phenotype” (Dawkins, 1982). Just as evolutionary biologists model genes, anthropologists can model “memes” as units of cultural selection that transmit and fixate within populations.

⁶Refer, for example, to the language of digital computation utilised by Ernst Mayr in his explication of the need to distinguish between proximate and ultimate levels of biological phenomena (Mayr, 1961).

To be sure, researchers have worked steadily over the past 70 years to nuance cognitive and evolutionary approaches to human behaviour, which has enabled more inclusive explanations of observable features of human behaviour and sociality. Evolutionary psychologists, for example, propose that evolved cognitive mechanisms (adaptations) may not predict survival or reproductive success in proximate contexts in which they are currently observable (as per the assumption utilised in human behavioural ecology known as the “phenotypic gambit;” see Grafen, 1984). Rather, evolved cognitive mechanisms influence behaviour in ways that were likely to have performed an adaptive function over evolutionary time (a theoretical formulation known as the “environment of evolutionary adaptiveness” (EEA) Cosmides, Tooby, & Barkow, 1992; Buss & Kenrick, 1998). Models of cultural evolution adjust population genetic models to take into account the observable differences between cultural and genetic information, such as culture’s capacity to support one-to-many transmission, the blending of cultural variants, and non-randomly guided variation (Cavalli-Sforza & Feldman, 1981; Boyd & Richerson, 1988). These adjustments are part of the concession that human cultural variants are not as dependent on high fidelity replication as their genetic cousins, but instead are shaped by evolved cognitive biases that favour the acquisition and transmission of some cultural variants over others due to their memorability or effectiveness (i.e., context sensitivity; see Henrich & Henrich, 2007). Meanwhile, the functional role of emotion (and not just rational decision making) has been foregrounded in neuroscience (Damasio, 1994), cognitive science (Lazarus, 1982), and various strands of developmental (Campos, Campos, & Barrett, 1989), social (Parrott, 2001), positive (Fredrickson, 2001), and cultural (Nisbett, 2003) psychology. Within evolutionary psychology, it has been recognised that emotion may have evolved as a superordinate mechanism for regulatory function (Cosmides & Tooby, 2000), and may play an important (albeit subordinate) role in regulatory function of decision making (Dalglish, 2004) and communication (Rime, 2009). In all of these approaches, however, the foundational assumptions of the MES (selection at the level of the phenotype according to inclusive fitness) and CR (primacy of explicit, propositional, or semantic processes

of information transfer) remain largely in-tact. As such, the role of physiological, social, and ecological dimensions of human cultural activity—including those that feature group exercise—are not afforded causal primacy, and therefore remain deemphasised in accounts of the natural origins of human life (Badcock, 2012).

To summarise, the first 70 years of cognitive and evolutionary approaches to human behaviour and sociality have produced explanatory models that tend to direct empirical attention to species-unique traits that can be understood to enhance inclusive fitness (in the case of evolutionary psychology) or otherwise facilitate cultural transmission (in the case of cultural evolution). While the MES has been groundbreaking for understanding human behaviour and sociality, these attempts do not yet satisfactorily account for the mysteriously visceral dimension to group exercise reported by Adrian and identified by Durkheim. In this thesis, I propose that a closer attention to the proximate mechanisms and dynamical properties of joint action can help bolster cognitive and evolutionary approaches to understanding the role of group exercise in human sociality.

1.3.4 Bondedness and sociality

More recent waves of scholarship have addressed the sidelining of physicality in human cognition and sociality. As Anthropologists Robin Dunbar and Susanne Shultz (2010) have aptly pointed out, humans do not merely adhere to a “dung fly” model of sociality, by incidentally *aggregating* in time and space according to genetically hard-wired protocols (see Wilson, 1975). Rather, humans actively *congregate* in structured, cohesive groups, which are held together by emotionally-mediated relational bonds (Dunbar & Shultz, 2010, p. 777). What makes human sociality unique, according to Dunbar, is the quality of “bondedness”—the human capacity to forge social bonds with genetically unrelated members, which results in a more adaptive ecological niche (see Odling-Smee, Laland, & Feldman, 2003). Because being able to maintain the effective functionality of a group through time may have very significant individual fitness benefits for its members, the emergent

property of sociality itself can be understood as part of the individual's fitness strategy (Dunbar, Gamble, & Gowlett, 2010; Nowak, Tarnita, & Wilson, 2010).

Dunbar argues that human bondedness and sociality cannot simply entail cognitive processes (at least not in the way cognitive processes are narrowly rendered by game-theoretic and gene-culture coevolutionary models; Dunbar & Shultz, 2010). Rather, bonded relationships involve two parallel and distinct mechanisms—a cognitive mechanism (derived from what Dunbar calls the “social brain” (Dunbar, 1998), or what has been otherwise understood as an evolved “norm psychology” (Chudek & Henrich, 2011)), and a physiological mechanism, in the form of an emotionally based form of attachment (Dunbar et al., 2010). By appealing to the physiological basis of relational ties between individuals, Dunbar scientifically reinstates the visceral dimension to human sociality that is observable in cultural activities involving group exercise.

Humans' evolved capacity for social bonding is thought to have arisen in primates as an adaptive response to the pressures of group living. Aggregating in groups serves to reduce threat from predation, but at the same time can be individually costly due to stress arising from interaction at close proximity, and conflict over resources among genetically unrelated individuals. These costs can lead the group to disband, and are hypothesised to have led to selection for social bonding via dyadic grooming, as the coalitional alliances that arise among grooming partners allow for the maintenance of the group by buffering the stresses of group living (Dunbar, 2012). Primate social grooming leads to the release of endorphins (a type of endogenous opioid, see Keverne, Martensz, & Tuite, 1989), presumably leading to sustained rewarding and relaxing effects (Dunbar & Shultz, 2010). While other neurotransmitters such as dopamine, oxytocin and/or vasopressin may also be important in facilitating social interaction, it has been suggested that endorphins allow individuals who are not related or mating to interact with each other long enough to build “cognitive relationships of trust and obligation” (Dunbar, 2012, p. 1839).

As the homo genus evolved more complex collaborative capacities for survival in interdependent group contexts (see Dunbar, 1998; Tomasello, Melis, Tennie,

Wyman, & Herrmann, 2012), grooming-like behavioural technologies (such as group laughter, music making and dance, and collective ritual) also evolved (via processes of multi-level cultural group selection, see Wilson, Vugt, & Gorman, 2008) to sustain social bonding in larger group sizes where dyadic grooming would take too much time (Dunbar, 2012; Tarr, Launay, & Dunbar, 2014; Launay, Tarr, & Dunbar, 2016). When mood-elevating effects are experienced in a group, they seem to lead to participants embodying each other's affective experiences, resulting in more positive, trusting, and cooperative relationships among participants (Dunbar, 2012).

Bondedness provides a testable theory for rigorously comprehending what Durkheim described as collective effervescence. Accounting for bondedness in human sociality requires, on an ultimate, evolutionary level of analysis, the loosening of a strict singular determinacy of fitness-based selection on cultural variants. In its place, bondedness suggests a multi-level (cultural group selection) or niche-construction approach, whereby individual-level benefits can be generated through the production and evolution of cultural activities involving genetically unrelated social actors operating within a shared ecological niche (Dunbar, 2012; Laland et al., 2010; Laland et al., 2015). On a behavioural or “proximate” level of analysis, bondedness requires a conceptual broadening of mechanisms of cognition to incorporate the causal role of physiological (as opposed to purely cognitive) mechanisms. In essence, social bonding provides the immediate (proximate) “social glue” for the ultimate process of social cohesion (see Lakin & Jefferis, 2003; Bastian, Jetten, & Ferris, 2014), and this achievement depends crucially on physiological (and not just cognitive) processes. Bondedness thus offers a suitable vehicle for an analysis of the visceral dimension of group exercise. As I argue below, however, existing theories of group exercise and social cohesion contain various gaps that can be addressed by more focussed attention to mechanism of physical and social coordination in joint action.

1.3.5 The social high theory of group exercise and social bonding

Research focussed on the proximate physiological, cognitive, and social mechanisms associated with group exercise confirms that group exercise is responsible for generating a psychophysiological environment conducive to social bonding. Anthropologist Emma Cohen and colleagues have recently identified bi-directional causal links between the two essential ingredients of group exercise—1) physiological exertion and 2) interpersonal movement coordination—and their common psychophysiological effects, including increased pain tolerance, athletic performance, positive affect, wellbeing, pro-sociality, and cooperation (Davis, Taylor, & Cohen, 2015). This evidence amounts to what can be called a “social high” theory of group exercise and social bonding (hereafter “the social high theory,” see Cohen, 2017). Here, social bonding is understood as the psychological experience of increased social closeness, which facilitates affiliation between non-kin group members (Tarr et al., 2014). I outline the key principles of the social high theory below, before identifying some empirical and theoretical aspects of the relationship between group exercise and social bonding that are not addressed by this theory, and which thus require further attention.

Physiological exertion

The social high theory proposes a causal link between physiological exertion and social bonding. Group exercise necessarily entails rigorous physiological exertion. The health and wellbeing benefits associated with regular physical exercise—including reduced risk of cardiovascular disease, autonomic dysfunction, and early mortality; as well as enhanced neurogenesis, cognitive ability, and mood—are becoming increasingly well-known (Blair & Powell, 1994; Nagamatsu et al., 2014). Evidence suggests that strenuous and prolonged physical exercise is modulated by the same neuropharmacological systems responsible for regulating pain, fatigue, and reward (Boecker et al., 2008; Raichlen, Foster, Seillier, Giuffrida, & Gerdeman, 2013). Neurobiological rewards in exercise are associated with both central effects (improved

affect, sense of well-being, anxiety reduction, post-exercise calm) and peripheral effects (analgesia), and appear to be dependent for their activation on exercise type, intensity, and duration (Dietrich & McDaniel, 2004). Exercise-specific activity of neurobiological reward systems offers a plausible explanation for commonly reported sensations of positive affect, anxiety reduction, and improved subjective well-being during and following exercise—extremes of which are popularly referred to as the “runner’s high” (Dietrich & McDaniel, 2004; Boecker et al., 2008; Raichlen et al., 2012). This neurobiological evidence maps on to more extensive literature concerning the psychological effects of exercise, which indicates a duration and intensity “sweet spot” for exercise and positive affect, whereby moderate-intensity exercise for durations of ~ 45 minutes appears most optimal (Reed & Ones, 2006).

It is possible that the function of exercise-induced positive affect extends to the realm of social bonding, particularly when achieved in group exercise contexts (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2009; Machin & Dunbar, 2011). Endocannabinoids and opioids have been implicated in mammalian social bonding (Fattore, Melis, Fadda, Pistis, & Fratta, 2010; Keverne et al., 1989), and in humans specifically, there is evidence that endorphins (a particular class of endogenous opioids) mediate social bonding (Dunbar, 2012; Shultz & Dunbar, 2010).

Interpersonal movement coordination

The social high theory also proposes a causal link between joint action and social bonding. Experimental evidence (predominantly from social psychology) suggests that time-locked coordination of behaviour between two or more individuals is conducive to psychological processes of self-other merging, liking, trust, and psychological affiliation. In these contexts, interpersonal coordination is primarily operationalised as behavioural synchrony—i.e., stable time- and phase-locked movement of two or more independent components (limbs, bodies, fingers, etc.; see Pikovsky & Rosenblum, 2007). Researchers suggest that synchrony enables a tight attentional union between individuals who match the timing and content of their actions, leading to the enhancement of interpersonal similarity and the blurring

of self-other boundaries in cognitive processing and recall (Cohen, 2017). Relative to non-synchronous group activities, synchrony increases social bonding and pro-social behaviour (Reddish, Fischer, & Bulbulia, 2013; Reddish, Bulbulia, & Fischer, 2013; Wiltermuth & Heath, 2009; Tarr et al., 2014)—an evolutionarily important outcome of bonded relationships. Recent studies have also found that, compared to solo and non-synchronous group exercise, synchronous group exercise leads to significantly greater post-workout pain threshold (Cohen et al., 2009; Sullivan, Rickers, & Gammage, 2014; Sullivan & Rickers, 2013b; Sullivan & Rickers, 2013a).

A recent meta analysis of the behavioural synchrony literature in social psychology suggests three candidate mediators of the relationship between behavioural synchrony and social bonding: 1) affective mechanisms implicating neuropharmacological reward systems (e.g., opioidergic and dopaminergic systems), 2) neurocognitive action-perception networks responsible for the experience of self-other merging, and 3) processes of group-centred cognition responsible for perception and reinforcement of cooperation (Mogan, Fischer, & Bulbulia, 2017). The current balance of existing evidence suggests that affective physiological mechanisms may be more relevant to joint action involving larger group sizes in which generalised feelings of euphoria and pro-sociality are common (e.g., mass religious rituals or music festivals; see Weinstein, Launay, Pearce, Dunbar, & Stewart, 2016), whereas neurocognitive mechanisms linking joint action and social bonding may be more applicable to smaller group sizes in which individuals can share and monitor intentions through ostensive communicative signals and implicit movement regulation cues (Lang, Bahna, Shaver, Reddish, & Xygalatas, 2017). Studies linking synchrony with social bonding and cooperation are supported by a literature than connects nonconscious mimicry with liking and affiliation (van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009).

The social high = exertion $\times$ synchrony

In addition to recorded independent effects of exertion synchrony, preliminary evidence suggests that exertion and coordination in group exercise interact to

produce social effects (Jackson et al., 2018). Social features of the exercise environment (for example, perceived social support, level and quality of behavioural synchrony, etc.) modulate exercise-induced mechanisms of pain and reward (Cohen et al., 2009; Sullivan et al., 2014; Tarr, Launay, Cohen, & Dunbar, 2015; Davis et al., 2015; Weinstein et al., 2016). This work is bolstered by existing literature on the social modulation of pain (Eisenberger, 2012), and links between pain and prosociality (Bastian et al., 2014). The social high theory thus combines these two bodies of literature to tell a story in which positive affect—associated with neuropharmacologically-mediated pain analgesia and reward—is extended to the social group via synchrony-activated cognitive mechanisms of self-other merging, and the perception and reinforcement of in-group cooperation.

1.4 Empirical knowledge gaps in group exercise

While the social high theory has served to empirically flesh out—particularly at the proximate level of analysis—the relationship between group exercise and bondedness, the theory does not account for a full spectrum of profiles and subjective experiences in group exercise. Even a cursory survey of human sociality reveals that group exercise scenarios often deviate markedly from the narrowly defined profile (the exertion $\times$ coordination sweet spot) and subjective experience of group exercise set out by the prevailing social high theory. In this section, I review some of the empirical gaps that remain unexplained by the social high theory. In particular, group exercise contexts often involve extreme (and not just moderate) levels of physiological exertion, as well as complex coordination demands (beyond exact synchrony). In addition, the effects of participation in group exercise appear to extend well beyond those of a feel-good social high, and into the realm of rich meaning making and fine-grained sensitivity to the click of joint action. I suggest that these empirical gaps in the social high theory point to a more fundamental *theoretical* gap in cognitive and evolutionary approaches to human behaviour. In short, the vast majority of cognitive and evolutionary approaches to human behaviour are unable to sufficiently account for the dynamical interlocking of physiological and

social processes. In this thesis, I suggest that the dynamical dimensions of group exercise contexts serve to bring this theoretical gap into sharp focus.

Group exercise involves both extreme physiological cost and profound meaning

Anecdotal and observational evidence suggests that group exercise contexts often entail extreme levels of psychophysiological exertion. High-stakes professional competitive sporting contexts (international-level sports such as rowing or ultra marathon running), extreme adventure sports (big wave surfing, free-diving), high-intensity contact (rugby union, American football, ice hockey) and combat sports (MMA, boxing, wrestling) are known to involve extreme physiological demands, often including high levels of pain. Although it is expected that extremely physiologically costly exercise contexts will involve activation of neurobiological reward mechanisms outlined above, some contexts may on average exceed (or alternatively never reach) the intensity and duration sweet-spot for optimal activation of neurobiological reward (Raichlen et al., 2013) or positive affect (Ekkekakis, Parfitt, & Petruzzello, 2011; Reed & Ones, 2006, see Appendix A.2 for more details on exercise-specific neuropharmacological effects)).

At the same time, group exercise involving extreme physiological, psychological, and social costs also appear to offer participants and observers an opportunity for profound meaning. Many people do not engage in exercise *just* for enjoyment or health; rather, in some contexts sport forms part of a life of purpose and self-discovery (see, for example Jackson, 1995; Jones, 2004; White & Murphy, 2011). Modern sport, for example, has always been much more than “just a game,” and instead offers an arena in which virtues and vices are learned, and the “morality plays”—of community, nation, or globe—thus performed (Elias & Dunning, 1986; McNamee, 2008). Psychological and physiological resilience in exercise contexts is lauded as virtuous, as is evidenced by the numerous idioms in the English language that receive currency in exercise lore: “when the going gets tough, the tough get going,” “no pain, no gain,” “you get out what you put in” and so on (Sarkar

& Fletcher, 2014). Activities in which group exercise feature, such as organised warfare, offer even more obvious examples of socially coordinated and physiologically exertive activity that is not for the mere purposes of a social high.

Whereas the social high theory predicts motivation for exercise based on “hedonic” enjoyment, anecdotal and ethnographic perspectives emphasise instead the ethical and moral dimensions of experiences, which social anthropologists contextualise within political processes relating to the construction of the self, community, and nation-state (Alter, 1993; Brownell, 1995; Downey, 2005; Wacquant, 2004). For example, anthropologists and sociologists have for some time emphasised the social function of exercise and sport in diverse cultural contexts, and various attempts have been made to analyse the phenomenological experience of exercise in terms of its sociological and psychological meaning (Bourdieu, 1978).

Social anthropologist Joseph Alter (1993), for example, argues that for wrestlers in north India, the body functions as a nexus through which the symbolic and material structures of the state, family, and the individual coalesce. In a similar vein, in a seminal ethnography of sport in China, cultural anthropologist Susan Brownell (1995), argues that sport functions as a crucial symbolic practice for the Chinese nation-state in a project of “rejoining the world,” and that the “micro-techniques” (c.f. Foucault, 1977) of this project entail significant cost to (and rich meaning for) the individual athlete. Similarly, French sociologist Loic Wacquant (2004), in an ethnography of boxers in Chicago’s south side, describes a “social logic” of physical activity, claiming that the costs associated with “the daily dedication and high technique that training demands; the regimented diet; the control, mutual respect, and tacit understandings necessary for actual fist-to-fist competition serve to create for the boxer an island of order and virtue” (Wacquant, 2004, p. 17). In many instances, it may be that the primary psychological motivation for exercise is not immediate, hedonic wellbeing, but instead *eudemonic* wellbeing, or the psychological awareness of a process through which life becomes “well-lived” (Fave, 2009; Huta & Waterman, 2013).

Group exercise demands complex coordination which can lead to team click

A similar connection between physiological, cognitive, and social processes in group exercise can be identified in processes of joint action typical of group exercise contexts. Currently, the social high theory has identified exact behavioural synchrony as an idealisation of coordinated joint action in group exercise that leads to social bonding. While some group exercise contexts do contain high levels of behavioural synchrony (rowing, synchronised swimming, diving, mass calisthenics, and forms of dance such as ballet, see McNeill, 1995), exact, in-phase synchronisation or matching of movements between co-actors is not typical of most instances of group exercise. More generally beyond group exercise, interpersonal coordination is more often achieved through flexible, function-specific assemblages of complimentary and contrasting behaviours (for example, coordination in an interactional team sport, a dyadic conversation, or an ensemble music performance, see Fusaroli, Racaszek-Leonardi, & Tylén, 2014). Real-world instances of joint action in group exercise usually entail various distinct action elements, organised hierarchically within a sequence (Schmidt, 1975; Rosenbaum, 2009). Successful execution of the “structure” of real-world joint action requires temporal and spatial precision and flexibility of movement across multiple timescales and sensorial modalities (Sebanz et al., 2006; Pacherie, 2012). All of these factors amount to potentially extreme levels of computational uncertainty in joint action contexts typical of group exercise (Bernstein, 1967), whose mitigation and regulation necessitate mechanisms of coordination of physical movement and social communication (Turvey, 1978). In essence, successful coordination in joint action typical of group exercise contexts requires considerable cognitive resources (Turvey, 1978), which are not budgeted for when joint action is modelled as exact in-phase synchrony (Keller, Novembre, & Hove, 2014).

At the same time, participants in group exercise contexts involving complex joint action often scrutinise the quality of coordination, and derive powerful psychological reward when complex joint action clicks (Jackson, 1992). Technically demanding

group exercise contexts such as competitive interactional team sports or music-making and dance, depend upon fine-grained precision of coordination of behaviours between individuals: the movements and goals of one individual must align precisely in time and space with the movements and goals of another. For highly skilled expert practitioners, often the ecstasy of group activity is contingent not just on reaching a certain level of physiological exertion, or resting on exact synchronisation of behaviours with others, but on the extent to which performance in joint action satisfies or exceeds implicit and explicit *expectations*. Consider the passage below, taken from a series of interviews that psychologist Susan Jackson performed with elite paired figure skaters:

It was just one of those programs that clicked. I mean everything went right, everything felt good . . . it's just such a rush, like you feel it could go on and on and on, like you don't want it to stop because it's going so well. It's almost as though you don't have to think, it's like everything goes automatically without thinking . . . it's like you're in automatic pilot, so you don't have any thoughts. You hear the music but you're not aware that you're hearing it, because it's a part of it all. (Jackson, 1992, p. 168).

Here, achieving success in technically demanding joint action is the source of rush, exhilaration, and amazement. This exhaltation may be due to the achievement of success in joint action, when the chances of success are highly improbable due to extreme levels of joint action complexity.

The psychological literature of “flow” and optimal human performance (see Csikszentmihalyi, 1992) suggests that athletes engaged in team coordination often report total absorption in and complete focus on the task at hand, a transformation of the experience of time (either speeding up or slowing down), and a blurring or transcendence of individual agency, or a “loss of self” (Csikszentmihalyi, 1992; Jackson, 1995; Jackson & Csikszentmihalyi, 1999; McNeill, 1995). Research suggests that flow often occurs in scenarios in which there are clear goals inherent in the activity, as well as unambiguous feedback concerning extent to which goals are either being achieved or not. In addition, scenarios most conducive to the experience of flow are those in which the technical requirements are challenging but achievable if

practitioners are able to extend (slightly) beyond their normal capabilities (Fong, Zaleski, & Leach, 2015). The coalescence of these factors is intrinsically rewarding and autotelic, activating both “hedonic” and “eudemonic” dimensions of subjective well-being (Huta & Ryan, 2010; Fave, 2009).

In sum, the social high theory is not equipped to explain instances of group exercise that deviate from a profile of moderate intensity exertion, exact synchrony, and a feel-good high. Anecdote and ethnographic observation suggest that, in addition to mood-elevating effects, group exercise contexts also involve extreme levels of physiological cost, rich psychological meaning making, cognitive complexity, and feelings of team click. Importantly, extreme physiological cost appears to be tethered to cognitive and social processes of meaning making and social identity (Section 1.4). Similarly, cognitive complexity in joint action appears to be linked to embodied, affective experiences of flow, eudemonic wellbeing, and team click. Together, these empirical gaps in the science of group exercise and human sociality suggest the importance of dynamic interlocking between physical movement and social communication in order for the social bonding effects of group exercise to be realised.

1.4.1 Attempts to address coordination of physical and social processes in social interaction

For some time, attempts have been made to scientifically account for the physical and embodied basis of social cognition. Researchers within cognitive science have argued that processes of information transfer in joint action are fundamentally shared between brains, bodies, and physical features of a task-specific environment (Hutchins, 1995; Kirsh, 2006; Susi & Ziemke, 2001). Theoretical formulation and empirical substantiation of this understanding of social cognition in joint action has, however, proven more difficult to achieve (due in part to the tendency of the MES and CR to preference the functional role of symbolic and amodal cognitive processes; see Semin & Cacioppo, 2008; Yufik, 2013). But, more recent advances in neuroimaging technologies (Frith, 2007), neurocomputational theories of brain function (Friston, 2010; Frith & Frith, 2010; Yufik, 2013; Clark, 2013), and constructive attempts

to extend the theoretical paradigm of human social cognition to account for inter-individual processes of interaction and coordination (e.g. Sebanz et al., 2006; Semin & Cacioppo, 2008; Dale, Fusaroli, Duran, & Richardson, 2014) have coalesced as a theoretical paradigm with testable predictions.

As I outline below, there is mounting evidence to suggest that humans' dual capacity for coordinating complex physical movement and elaborate social communication are tethered by a functional imperative to regulate high levels of uncertainty in social interaction. In this thesis, I define uncertainty in information-theoretic terms as a quantity that reduces an individual's ability to successfully predict, anticipate, establish, and sustain joint action (Shannon & Weaver, 1963). As I explain in more depth in the following chapter, joint action, relative to individual action, is defined by high levels of uncertainty, owing to its cognitive complexity. Moreover, joint action scenarios typical of group exercise contexts are defined by extreme levels of uncertainty relative to quotidian social interactions.

In emerging dynamical approaches to social cognition of joint action, the ultimate—thermodynamically inspired—mandate to reduce uncertainty drives dynamic coordination between neural models that predict the likely causes of sensory stimuli, and extra-neural affordances that function to verify and enhance these predictions (Friston & Frith, 2015a; Ramstead, Veissiere, & Kirmayer, 2016). In effect, this approach suggests that higher levels of coordination between neural models and their relevant affordances will lead to more adaptive behaviour, by virtue of reducing uncertainty inherent in an organism's exchanges with the environment (Friston, 2010; Ramstead, Badcock, & Friston, 2017). When applied to joint action, the dynamical approach suggests that higher levels of (actual or perceived) coordination of physical movement generates higher levels of social alignment between co-actors (Semin & Cacioppo, 2008; Wheatley, Kang, Parkinson, & Looser, 2012).

Evidence for the imperative of coordination can be identified on the level of physical movement in the form of “functional interpersonal synergies” (Riley, Richardson, Shockley, & Ramenzoni, 2011) between co-actors and action-perception coupling

between sensorimotor processes of skilled practitioners in joint action (Novembre & Keller, 2014). Meanwhile, evidence for the imperative of coordination on the level of social communication can be identified in strategies such as the attribution of agency, to facilitate delineation of roles and responsibilities in joint action (Wolpert, Doya, & Kawato, 2003; Sato, 2008; van der Wel, Sebanz, & Knoblich, 2012), or the use of type-based social heuristics of evaluation (e.g., personality type or social standing; see Moutoussis, Fearon, El-Deredy, Dolan, & Friston, 2014)—both of which enhance predictability of future action by reducing computational uncertainty. In addition, participation in systems of explicit communication—contingent upon shared recognition and participation by groups of others (Ramstead et al., 2016)—functions to “smooth” coordination of joint action by providing shared referents for action planning and prediction (Vesper et al., 2017). Importantly, all of these strategies of physical and social coordination function to reduce the information-theoretic uncertainty inherent in social interaction.

In sum, existing evidence deriving from dynamical approaches to social cognition supports an investigation into the role of uncertainty and coordination in joint action as a source of social bonding in group exercise. Research suggests the possibility that higher levels of coordination in physical movement could generate higher levels of coordination of social communication, identifiable as processes characteristic of social bonding. In this thesis, I propose that the activation of the pathway between coordination of physical movement and social bonding requires, crucially, that joint action “clicks.” In the following chapters, I first develop a general account of team click in group exercise, before situating and testing this account in the real-world group exercise setting of rugby in China.

1.5 When the rugby team in China clicks

To summarise the ground covered thus far: this thesis is driven by the overarching aim of contributing to an evolutionary explanation for puzzling ubiquity of group exercise in the more recent human record. Existing cognitive and evolutionary accounts suggest a relationship between group exercise and social cohesion, due

in part to the way in which group exercise contexts uniquely generate social bonding between participants. The social high theory posits that social bonding in group exercise can be explained by the way in which physiological exertion and interpersonal movement coordination combine to generate a psychophysiological environment conducive to affiliation and trust. However, the social high theory is unable to—and, indeed, does not attempt to—account for a full spectrum of experiences of group exercise. In particular, anecdotal and ethnographic evidence suggests that group exercise is defined by instances in which physical and social processes appear to coordinate: the physiological cost of group exercise is associated with rich social meaning, while the cognitive complexity of joint action in group exercise is associated with perceptions of team click. I suggest that a dynamical approach to the social cognition of joint action may help shed light on these gaps.

1.5.1 Research questions

The aims of this thesis lead me to formulate four key research questions (see Table 1.1). The core question I seek to answer in this thesis is how joint action generates social bonding in group exercise contexts (thesis question). In order to directly address this question, I develop a general theoretical account of team click in group exercise (Chapter 2), which I then situate (Chapters 3 and 4) and subsequently test, by drawing upon ethnographic and field experimental data (Chapters 5 and 7). Throughout this process I pay specific attention to the component mechanisms of team click (mechanism question).

As such, in this thesis, I focus the bulk of my attention on testing the claim that team click explains a link between joint action and social bonding (thesis question), and interrogating team click’s components mechanisms (mechanism question). I do not completely lose sight of questions relating to the role of individual or cultural variation, or the implications of the phenomenon of team click for broader evolutionary questions of social cohesion and cultural evolution. However, considering humble scope of this thesis, I do not formulate specific hypotheses for these questions, but rather maintain awareness of them in the background of analysis

Table 1.1: Research questions

Type	Question
1 <i>Thesis</i>	What is the relationship between joint action and social bonding in group exercise?
2 <i>Mechanism</i>	What processes explain the bonding effects of joint action in group exercise?
3 <i>Variation</i>	How does the relationship between joint action and social bonding vary according to activity, culture, or individual differences?
4 <i>Evolutionary</i>	What is the relationship between group exercise and social cohesion?

as secondary concerns. In addition, I return to a discussion of team click in an evolutionary perspective in the general discussion (Chapter 8).

This thesis progresses in a step-wise fashion, both theoretically and empirically. First, I review existing research from anthropology, psychology, and cognitive science in order to transition from research questions to research hypotheses pertaining to a general account of team click in group exercise. Second, I situate and contextualise these hypotheses within the research setting of rugby in China, in order to assess their validity and explanatory potential for real-world settings of group exercise. Third, I formulate and test selected predictions derived from research hypotheses within either more representative or more controlled field experimental paradigms. This gradual, step-wise development of theoretical formulation and empirical application is suitable for this thesis, in which I attempt to chart novel theoretical territory.

1.5.1.1 Research setting and method

I focus my empirical research on a group exercise setting well suited to addressing my research aims and questions. “Rugby” and “China” are two words that are not usually mentioned in the same sentence. Rugby union (hereafter “rugby”) is a dynamic field-based contact sport that requires of its participants high levels of

physiological exertion and complex coordination of joint action (see Chapter 3.3). “A game for barbarians played by gentlemen,” rugby first took root in the elite education institutions of Britain’s colonial empire, and in many of the contexts in which it is commonly played, rugby is anecdotally and colloquially associated with experiences of team click in joint action, as well as social processes of group membership (Dunning & Sheard, 2005).

China has enthusiastically adopted sport and exercise at different stages throughout the nation’s turbulent modern history. But for most of this history, rugby accorded neither with a dominant Olympic-centred logic of the state sport system, nor with dominant cultural dispositions and modes of understandings physicality (which derived from hundreds of years of continuous history of Confucian and Daoist traditions of thought, see Morris, 2004). Rugby was eventually officially established in China in 1990, as a university sport program at the Chinese Agricultural University (CAU). But, in 2009, when rugby became an Olympic sport in the form of “rugby sevens” (the modified seven-a-side version of rugby), rugby was immediately “embosomed” (*huaibao* 怀抱) by the state-sponsored sport system and afforded various institutional resources and infrastructure (Xu, 2010). At the time of writing, more than ten of China’s 34 provincial level prefectures now have full time men’s and women’s professional programs.

In addition to these motivations, my personal qualifications as a researcher afforded me with a unique opportunity for research in this particular setting. My combination of expertise in rugby union (as an ex-professional rugby player), experience in China (professionally fluent in Modern Standard Chinese (Mandarin), and familiarity with rugby in China specifically (e.g., as coach of the Chinese national men’s youth team in 2013) meant that I had privileged access to research opportunities ranging from in-depth ethnography to *in situ* field experimental studies (for a full explanation of research qualifications, see Appendix C.1).

Considering the novelty of the theoretical claims proposed in this thesis concerning the phenomenon of team click, and combined with my unique qualifications as a researcher, in-depth ethnographic and field experimental research in rugby

in China offered a fruitful avenue for research. Through my years training with (and coaching) Chinese rugby teams, I already knew that there was a specific lexicon for describing optimal coordination in joint action. The most commonly used term to describe optimal yet effortless coordination in joint action is *moqi* (默契; pronounced “more-chee”). *Moqi* refers specifically to the phenomenon of “tacit understanding” between two or more actors engaged in a joint activity (Pleco, 2018). More generally, and much like the English verb “click,” *moqi* can be used to describe any instance of social activity that involves tacit, unspoken understanding or coordination between co-actors: from sport, to music, even to Chinese comedic “cross talk” (*xiang sheng* 相声). In addition to tacit understanding, I would also often hear athletes describe the importance of the “atmosphere” (*qifen* 气氛) or “aura” (*qichang* 气场) between co-actors or within a team. Thus, I was confident that I would find evidence for the experience of team click in group exercise.

1.5.2 Preview of findings

In general, ethnographic evidence revealed that athlete experience of team click were associated with subjective perceptions of on-field performance and processes characteristic of social bonding. The tacit and embodied “awareness” (*yishi* 意识) required of athletes can be both the source of high levels of social anxiety and stress, as well as the source of extreme exhilaration and motivation when joint action clicks. In addition, the athletes I studied derived rich resources from their adherence to rugby for processes of personal and social identity formation, and it appeared that these resources increased with familiarity and experience with both on- and off-field requirements for membership. This novel evidence of the relationship between joint action, team click, and social bonding validated my research hypotheses, and motivated the formulation of specific predictions and field experimental methods designed to test them.

Subsequently, I conducted two quantitative studies “in the field.” While control and sampling constraints of field experimental methods do allow for causal inference and hypothesis testing in a strict sense (based on the assumptions of stringent

randomisation and controlled conditions), they nonetheless over an opportunity to derive meaningful (i.e., statistical) associations between variables of interest based on theoretically-motivated predictions (Xygalatas et al., 2013). In this phase of my research, I once again advanced in a step-wise manner. First, I found a significant positive relationships between perceptions of team performance, team click, and social bonding *in situ* during a National rugby tournament ($n = 174$). These results then motivated a between-subjects training experiment paradigm ($n = 58$), in which I attempted to manipulate uncertainty in joint action as a predictor of more positive expectation violation, team click, and social bonding. Results in this study failed to confirm predictions; there were no condition-wise effects of uncertainty on perceptions of confidence, positive expectation violation, team click, or social bonding. However, a secondary analysis of all participants collapsed into one sample did provide some confirmatory results, suggesting that the null findings can be explained by limitations in the study design, as opposed to ill-formulated hypotheses.

In sum, this thesis scientifically interrogates the moment in which the team clicks, by formulating a general theoretical account of team click in group exercise, and testing this account in rugby in China. Results provide novel (albeit provisional) evidence for a relationship between joint action, team click, and social bonding, and suggest that scientific explanations for the prevalence of group exercise in human sociality can stand to benefit from closer attention to the mechanisms of joint action.

We hear a lot these days about genes and molecules, but how does one human brain, or one human being coordinate, or entrain, or resonate with another? We may not realise it, but we live in a world of coordination, at every level and every scale of endeavour.

— J. A. S. Kelso *Coordination and the Complimentary Nature* Presentation to the New York Academy of Sciences - May 12, 2010

2

A general account of team click in group exercise

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2.1 The development of visceral agency in rugby's newest recruit

Sun Hongwei arrived, escorted by his high school athletics coach, to the Beijing Temple of the God of Agriculture Sports Technology Institute (*Beijingshi xian-nongtan tiyujishu yundong xuexiao* 北京市先农坛体育技术运动学校, hereafter the Institute) soon after I began my fieldwork in August 2015. An 18-year-old with a slight build and timid demeanour—his gaze remained diverted to the ground during his first few months at the Institute. Hongwei later told me that he had never seen a rugby ball before that day he arrived.

Hongwei was from Hebei province, immediately surrounding the special prefecture of Beijing, China's capital. Hongwei's coach had organised a trial for Hongwei with the Beijing Provincial men's and women's Rugby Program (hereafter the Program) by calling upon social connections to the leadership of the Institute. Athletes come to the Rugby Program from all over the country. As I explain in more detail in Chapter 3, to represent Beijing at a provincial level in a sport like rugby can translate into the opportunity to gain entrance to one of China's top universities and enhanced career employment opportunities thereafter.

Rugby is not a popular sport in China, but its recent inclusion in the Olympic games (in the form of the modified seven-a-side version of "rugby sevens") means that it now occupies a prominent place in the Chinese sport system. Rugby programs such as the one at the Institute now exist in 12 of China's 34 provincial level prefectures, either embedded within, or somehow associated with, tertiary education institutions. Thus, although rugby and China are not commonly associated terms, rugby now affords Chinese athletes a rare and under-capitalised opportunity to pursue attractive life-course opportunities of education and employment in an intensely competitive education system.

Without exception, the athletes who arrive at the Institute to join the rugby team are not like me. They have not spent their childhoods playing rugby in their schoolyards or watching professional rugby on television. Many who come to rugby transition from other more popular sports such as athletics, basketball, or

association football, and often—like Hongwei—have never seen a rugby ball before they arrive. Most athletes start from scratch, so to speak, in terms of their grasp of the requirements of the highly interactive and technically complex team sport. In addition to complex patterns of movement coordination, rugby also involves unrestrained body-on-body collisions and intense bouts of high physiological exertion. To perform all of rugby's technical requirements successfully requires a combination of speed, strength, agility, and endurance (see Chapter 3.3). Learning the game of rugby from a baseline of essentially zero, while also navigating the inevitably demanding social and political dynamics within the team and the Institute, was clearly going to be a daunting task for Hongwei.

* * *

Even compared to other newly arrived junior athletes, I noticed that Hongwei was particularly timid and shy, especially in his interactions with the senior players and coaches (myself included). Nevertheless, Hongwei clearly signalled diligence and commitment through his participation in team activities. He arrived early to each training session, and carried more than his fair share of the training equipment—a task shared by the most junior members of the team. Each time I passed Hongwei in the corridors of the Institute, he would greet me with a polite bow and greeting: “Hello, Coach” (*'jiaolian hao'* 教练好). In these instances, Hongwei would coordinate his greeting with a moment's eye contact, only to return his gaze to the floor and continue walking.

Due to his lack of familiarity with the basic techniques of rugby, Hongwei was initially unable to fully participate in normal training with the rest of the team. Instead, during the first month or so, Hongwei remained on the sidelines of the field and practised the basics with other athletes who were unable to fully participate in training due to injury. He began with the absolute basics: learning how to pass and catch the rugby ball, while stationary and while running in-motion. In my eyes at least—eyes of an observer accustomed to instinctual grasp of these movements from a young age—I found Hongwei's attempts to accustom himself to the skills of rugby

jarring. The idiosyncrasies of rugby's ovular ball often foiled him. I would regularly see him on the sidelines of training chasing after a ball that he had just fumbled; the idiosyncratic shape of the ovular rugby ball meant that it would change direction like it were a scurrying rabbit tactfully evading its pursuer.

* * *

I interviewed Hongwei approximately six weeks after he arrived at the Institute. Hongwei's demeanour during the interview was consistent with the timid and shy one that he presented publicly at training. As I explain below, he did show some signs of captivation with his new sport and social environment. When I asked about his initial impressions of the on-field demands of rugby, however, Hongwei was quick to confess that he felt utterly unacquainted:

SHW: I still haven't really started to practise any of the team plays or anything; all I can do so far is pass and run a little bit...(but) it's quite fun!

JT: What do you think is the most difficult component of rugby?

SHW: Um... well, coordinating with teammates [on the field], particularly coordination in attack. Because I can't figure it out. When I first arrived, I didn't even know what a "switch play" or a "blocker play" was.

SHW: 战术没怎么接触，就是像传球啊、跑动什么的会一点了

JT: 感觉怎么样？

SHW: 挺好玩的！

JT: 你认为橄榄球最难的一部分是什么？

SHW: ...打配合，进攻的配合，因为搞不明白，刚来的时候也不知道什么交叉，后插什么的

Hongwei was self-critical in this confession regarding his minimal grasp of the technical requirements of joint action in rugby. The obvious stress and anxiety he expressed was indicative of a broader trend with the other athletes I interviewed, as I will explain in more detail in the ethnographic sections of this thesis (see Chapters 4 and 5). When athletes were asked in interviews about the most difficult aspect of rugby, on-field coordination with teammates was by far the most common answer, particularly among the new recruits and most junior athletes.

As I directed the interview towards topics beyond the on-field technical demands of rugby, Hongwei was more positive, framing rugby as an exciting new opportunity, and commenting that his friends and family were in awe of the fact that he is playing such an impressively “strong” (*qiangzhuang* 强壮) physical sport like rugby. When I asked him about something new that he had learnt through playing rugby, Hongwei automatically responded by emphasising the social dimensions to his experience at the Institute:

...I think it's mainly this thing of having teammates. Before, when I was training for an individual sport, it was just me training by myself. [In that environment] it was a case of whoever trained well was successful. But now with this team of brothers, elder teammates will take care of younger teammates. We all train together, and if you can't do something, you can always ask your elder teammates...[Rugby] is so much better, because in an individual sport, if you can't master something, you have to go to your coach for help. Other athletes don't want to teach you, because if you surpass them, then they have to work even harder to keep up... I have had to learn about helping others, because rugby is not like an individual sport, where you look after your own performance and that's it. In a team sport, if you don't do well, there's no need to get too frustrated or upset, because other athletes will help you out, and I will also help others out—that type of collaboration with each other.

我觉得主要是师哥师弟的这一块儿，原来练个体项目都是自己练自己的，谁练好了谁厉害，但是现在师哥师弟，有师哥照顾师弟带着，互相练，我不会我可以问师哥 ...因为个人项目你不会就必须要找教练，但是别人不愿意教你，因为你把别人超越了那别人还还得努力。学到互相帮助，因为向个体项目自己成绩自己来拿就行，而像团体项目，即使自己做不好，也不用太泄气太沮丧，因为别人会帮你做好，我也会帮别人做好，互相协作的那种。

Hongwei's explicit reference to the collegiality of the team, and his position as junior member, highlights that the technical skills of rugby were not the only novel components of his experience. Hongwei's background was in athletics (his event was pentathlon, very much an individual sport), and the team environment was completely new to him. This was also the case for many of the other athletes in the team. As I listened to his reflections about rugby and group membership, I could not help but associate the quality of these explicit declarations of group membership with his overly mechanical imitation of rugby's foundational techniques. In both,

I saw his willingness and desire to signal commitment; but both lacked—at the outset at least—a certain level of grasp or conviction. In the case of his explicit celebration of rugby's social resources in interview, for example, I got the impression that Hongwei was telling me what he thought he ought to say, without deeply believing these things to be unequivocally true.

* * *

A few months passed, and Hongwei continued to train. He was as eager and committed as when he began, and I did notice some gradual improvement in his grasp of rugby's basic skills. But he also remained extremely reserved, keeping his head low at all times in team settings, unless addressed by senior players or coaches.

Then, one evening when I had returned to my room in the Institute dormitory from a three week hiatus in Australia for Christmas, I heard a knock on my open door, and to my surprise Hongwei took an assertive stride into my room, carrying in two arms a draw-string bag containing rugby balls (which were in need of more air before the next day's training session). Hongwei had never ventured into my room before, apart from when I invited him in for our first interview two months earlier—but certainly never before had he entered on his own accord. Hongwei looked me straight in the eyes with his head held high and energy radiating from his face and upright chest. I could not help but smile and ask, with genuine intrigue, "How have you found training recently?" (最近练得怎样?) "Very good" (很好) he said, assertively and excitedly. "Much better than before. At least now I know what's going on at training, I can keep up with the plays!" (比以前好多了, 至少现在训练的时候知道该干什么, 战术什么的能跟得上!) A big smile spontaneously grew on his face as he continued to hold my gaze confidently. "Oh good!" (好啊!) I said, a little bit shocked. I congratulated him for his hard work in training while I had been away, and encouraged him to keep at it. At this, Hongwei took leave by bowing politely and saying "Thanks, Coach" (谢谢教练). "Wow," I remember thinking to myself. What quantity had all of a sudden possessed Hongwei? Was

it possible that his diligent adherence to rugby over those first four months at the Institute had instilled him with a visceral sense of personal and social agency?

* * *

2.2 A general account of team click in group exercise

How can we scientifically account for the unmistakably visceral and agentic quality of Hongwei's transformation from timid newcomer to budding Beijing rugby player? As the story of Hongwei anecdotally suggests, the physical and social dimensions of experience in group exercise may take time to develop. Presumably in Adrian I witnessed the finished product: through many years of on- and off-field engagement with the sport of rugby, Adrian came to personally embody rugby as a social identity, and was thus able to profess its carnal mystery from a place of deep, intuitive knowing (see Chapter 1.1). When I met him during my first stint of research at the Institute, Hongwei was only just beginning this journey. Over an extended period of ethnographic research it became clear to me that—for Hongwei and others like him—a combination of an increase in familiarity with the on-field technical requirements of rugby and increased familiarity with the off-field social regularities of being an athlete at the Institute brought an increase in personal confidence, and a sense of group membership. As explained in the previous chapter, a scientific theory capable of accounting for these dynamic and interlocking physical and social dimensions of group exercise is yet to be fully formulated.

In this chapter, I draw on existing empirical evidence and prevailing dynamical theories of social cognition to formulate a novel theoretical account of team click in group exercise. I introduce the phenomenon of team click as a psychological construct capable of explaining the relationship between joint action and social bonding in group exercise settings.

I begin by reviewing empirical evidence for the phenomenon of team click, noting team click's visceral and socially agentic experiential dimensions. Following this

empirical grounding of team click, I then develop a novel theory of team click in group exercise. This theory is based on a dynamical conception of joint action, in which physical and social processes are integrated into one overarching inferential framework driven by the mandate of reducing uncertainty. Drawing upon this relationship, I hypothesise that the visceral and socially agentic dimensions of team click arise from more positive perceptions of team performance, and, in turn, lay the foundation for processes of social bonding. In addition, I propose that positive violations of team performance may function as an important precedent to team click, directing attention to its visceral and socially agentic dimensions.

Following this theoretical review, I outline the research hypotheses of a general account of team click in group exercise, which I subsequently test via ethnographic and field experimental research.

2.3 The empirical phenomenon of team click

In this section, I draw upon evidence from sporting anecdote, psychology, and anthropology in order to outline the empirical foundations for the phenomenon of team click. In addition, I point to evidence for team click as an explanatory construct linking joint action and social bonding in group exercise—a proposal which I justify theoretically in the following section.

One of the big mysteries of competitive team sport, particularly at the elite level, is the elusiveness of peak team performance. While each individual athlete may exhibit expert-level competence in sport-specific skills, the much sought after aggregation of these components, i.e., a team that consistently performs “in the zone,” and “firing on all cylinders,” in reality often proves frustratingly difficult to achieve and sustain. As King and de Rond (2011, p. 568) note in their ethnography of the 2008 Cambridge University rowing crew who participated (and who were eventually victorious) in the famous annual Boat Race against Oxford University, the search for collective rhythm is a universal in human social interaction, but the physiological and psychological complexity of finding that rhythm “...is extremely difficult to attain; collective performance is a possibility not a certainty.” The

moment in which everything “clicks” into place in team sport can, for various reasons, disappear as abruptly as it arrives, if indeed it arrives at all.

When team click is somehow cultivated, and even sustained, it is celebrated as the ultimate, albeit often inexplicable magic of sporting feats. Consider Leicester City Football Club’s unbelievable outhouse-to-penthouse title run in the 2015 English Premier League, the recent dominance of the Golden State Warriors in the American National Basketball Association (NBA), or the astonishingly consistent performance of the New Zealand men’s national rugby union team (the “All Blacks”).¹ All of these successful teams carry with them a powerful “aura” associated with their capacity to effectively coordinate their behaviours on the field over extended time scales: individual games, seasons, and, in the case of the All Blacks, entire generations. The aura associated with such rare instances of sustained collective performance in elite sport can spur limitless fascination, fandom, and elaborate exegesis.

For athletes, coaches, and spectators alike, team click can be a hugely powerful sensation. As theologian Michael Novak explains, “[f]or those who have participated on a team that has known the click of communality, the experience is unforgettable, like that of having attained, for a while at least, a higher level of existence” (White & Murphy, 2011, p. 11). For the purposes of this thesis, I use the term team click to describe the phenomenology or perception of peak performance within a team of athletes engaged in joint action, but the term has potentially broader applications beyond group exercise (for example, in music making, spoken conversation, or other similar activities).

As explained in Chapter 1.4, the experience of optimal performance in sport has been extensively documented in the psychological literature of flow (Csikszentmihalyi, 1992; Jackson, 1995; Jackson & Csikszentmihalyi, 1999; McNeill, 1995). Psychologists and neuroscientists have scientifically studied the experience of flow, and have tabled a series of neuropharmacological (Boecker et al., 2008), neurocognitive (Dietrich, 2006; Dietrich & Audiffren, 2011; Labelle, Bosquet, Mekary, & Bherer, 2013), and psychological (Csikszentmihalyi, 1992) theories

¹The All Blacks are arguably the most successful sporting team ever, with a winning percentage of 77% in the last 150 years (and 88% in the last 6 years) (Kerr, 2013).

for its emergence. The vast majority of flow research has focussed on the experience of the individual—the athlete, musician, or performer. Some attempts have been made to extend an analysis of flow and its antecedents to the level of the group and dynamics of interpersonal coordination—a phenomenon termed “group flow” (Sawyer, 2006)—but these attempts lack coherence and development. Anecdotal and observational evidence suggests that in addition to the components of flow already identified at the level of the individual, successful performance of technically complex *joint* action could have distinct psychological and social consequences.

In this thesis, I suggest that team click is distinct from flow in that it specifically delineates perceptions of joint action from individual action, and therefore implicates physiological, cognitive, and social mechanisms unique to joint action (Vesper et al., 2010). In particular, team click in joint action entails an added level of complexity owing to the cognitive uncertainty inherent in coordinating behaviour with autonomous co-actors. As I explain in more detail in the theoretical section below, there is evidence to suggest that the cognitive uncertainty of dynamic joint action may also be the source of social effects characteristic of social bonding, specifically when the uncertainty of joint action is mitigated via successful coordination of movement.

2.3.1 Phenomenological components of team click

It is reasonable to assume that the psychological phenomenon of team click will share many similarities with the visceral and autotelic components of experience associated with flow (Sawyer, 2006). In addition, it is likely that team click will involve an extra phenomenological dimension, owing to its inherently social features. Team click is anecdotally present in a wide range of joint action contexts, and is often associated in these contexts with psychological processes of positive affect and wellbeing, as well as personal and social agency, social affiliation, and group membership (Jackson, 1995; Marsh, Richardson, & Schmidt, 2009; Wheatley et al., 2012; Slingerland, 2014).

Tightly synchronised activity in particular, found in team sports such as rowing, can help dissolve the boundaries between individual and social agency: “In rowing...it feels like you have at your command the power of everybody else in the boat. You are

exponentially magnified. What was a strain before becomes easier. It is absolutely the ultimate team sport” (Brown, 2016, p. x). The blurring of agency between self and team may be responsible for facilitating affiliation and trust between teammates in competitive athletic environments such as professional rugby, which often involves high physiological stress and uncertainty. As Jeremy Paul, a famous Australian Rugby player commented of his late teammate, Dan Vickerman:

...you always wanted a guy who would go into the trenches with you and he always played consistently well...he could really play and was just one of the good lads that you enjoyed his company (Fox-Sports, 2017).

As this excerpt suggests, the experience of team click may act as a social diagnostic tool, whereby perceptions of successful performance with co-actors could drive attribution of social inferences of competence and reliability to co-actors.

The experience of team click, like flow, also often involves an experience of awe or exhilaration arising from perceptions of successful performance of joint action. While elite athletes presumably always aim for optimal performance in joint action, the experience of achieving that desired state, and even exceeding it—often with the help of co-actors—appears to be a powerful, and somewhat “surprising” experience. In the 1990s, psychologist Susan Jackson conducted a number of qualitative studies documenting athletes’ (in this case elite figure skaters) experience of flow in solo and joint action:

Oh, it’s awesome! Everything’s at peace...the crowd was involved, we were involved as a pair team, and we were just aware of everything, it just kept snowballing, like we weren’t going to miss, and it was great, it was an awesome experience (Jackson, 1992, p. 168).

Here, the athlete appears to be surprised and in awe of the achievement of optimal collective performance. Part of the awesomeness may derive from the rare feeling of absolute alignment between self and co-actor(s):

What was really so special about this performance was that there was nothing between (partner’s name) and I but flow. You know, through the whole three minutes. That meant that her mind and my mind were clear and in the same...in a partnership. It’s always adjustments for

“Am I?” and “Are You?” and “Where Are We?” and stuff like that. That day was really a marriage of (partner) and (self) and the ice. So I think it’s a different kind of flow experience than a single skater who has much more control over themselves. (Jackson, 1992, pp. 173-4).

This passage draws attention to the fact that joint action—more so than individual action—entails additional cognitive demands of attending to the movements and intentions of others (Vesper et al., 2010). The achievement of click in joint action might be associated with the reduction or down-regulation of cognitively effortful processes of monitoring self and other contributions to joint action (Dietrich, 2004a). Research suggests that optimal coordination in joint action may be defined by a combination of patterns of fluent, “co-confident” movement (Noy, Levit-Binun, & Golland, 2015; Noy, Weiser, & Friedman, 2017, in place of effortful monitoring; see), and a “we-mode” of social agency in which the contributions of “you” and “I” are momentarily transcended or abandoned (see Gallotti & Frith, 2013). The experience of team click could therefore be a powerful signal of shared commitment to joint action and willingness to cooperate (Reddish, Bulbulia, & Fischer, 2013).

In sum, team click refers to perceptions and experiences of peak team performance in group exercise contexts. Based on this brief review of anecdote and evidence from psychology, anthropology, and further afield, an individual’s perception of team click should contain some or all of the components outlined in Table 2.1. Team click can involve perceptions of tacit (rather than explicit) understanding between co-actors, experience of autotelic flow or coherence of joint action, a quality of aura or atmosphere around the team, a blurring of agency between self and teammates or group, and perception of reliability of others and self in performing their roles. These six phenomenological components of team click can be reduced to two main dimensions: viscerality, and social agency. As I develop in more detail in the theoretical section of this chapter, there is evidence to suggest that the combination of viscerality and social agency provide a cognitive template for processes of social affiliation and identification characteristic of social bonding.

Table 2.1: Phenomenological components of team click

Component	Description
Viscerality	
Tacit understanding	Perception of unspoken or implicit alignment of expectations with co-actors
Group flow	Perception of flow or coherence in joint action
Atmosphere or aura	Perceived positive, energetic quality within or surrounding the team
Social Agency	
Blurring of self and other agency	Blurring of distinction between self and other agency in joint action
Ability extended by others	Feeling that individual abilities are extended by the agency of others
Reliability of self and others	Perceived certainty concerning the ability of self and others to contribute effectively to joint action

2.3.2 The theoretical challenge for a scientific understanding of team click

Researchers have pointed out that flow—a concept that shares many similarities with team click—has traditionally escaped rigorous scientific analysis (Dietrich & Stoll, 2010; Slingerland, 2014). Dietrich, for example, explains that flow presents a paradox that is difficult to explain according to traditional theories of attention and mental effort, which tend to assume that better performance, on any task, is associated with increased conscious effort allocated to that task (Dietrich, 2004a). As Slingerland (2014) surmises, flow reflects a paradox in which an individual in flow appears to be “trying not to try.” Flow appears to entail spectrum of both effortful (intentional, mental) and seemingly effortless (implicit, automatic) cognitions—some

of which appear to depend on the resources beyond the brain. Team click, like flow, is a multidimensional process involving mental, embodied, emotional, and social dimensions. In this thesis, I consider the suggestion that the most effective way to reconcile the analytical paradox associated with flow, team click, and the mystery of group exercise more generally is via a more dynamical and integrative model of cognition (Clark, 2015a). In the sections that follow, I outline the building blocks necessary to formulate a novel theory of social bonding through joint action.

2.4 A theoretical account of team click in group exercise

To formulate a general account of team click in group exercise, I begin by developing a theoretical grounding for team click based on the proposed relationship between uncertainty and coordination of physical movement and social communication in joint action. Emerging dynamical perspectives on social cognition suggest that positive perceptions of team performance in joint action and social bonding may be causally linked by an overarching mandate to reduce levels of uncertainty in joint action. I suggest that the visceral and socially agentic experiences of team click can be explained as responses to instances of *unexpected* success in team performance. In particular, positive violation of expectations concerning team performance could set the foundation for experiences of social agency and viscosity. Finally, I present evidence to suggest that experiences of agency and viscosity characteristic of team click could serve as a necessary sensorimotor foundation for more elaborate and culturally-mediated processes characteristic of social bonding. In fact, as I explain below, a dynamical theoretical approach to social bonding suggests the reverse: social heuristics, rationalisations, beliefs, and group identities characteristic of social bonding serve as functional affordances through which brains reduce the “mystery” of social interaction. Together, these components form a general theoretical account of team click in group exercise, whereby team click mediates a relationship between perceptions of team performance and social bonding.

Following this review, I formulate two hypotheses. The first hypothesis proposes a relationship between perceptions of team performance and social bonding, mediated by team click (H1). The second hypothesis claims that better-than-expected execution of joint action will mediate a relationship between prior levels of uncertainty and team click (H2). Specifically, higher levels of uncertainty in joint action will lead to higher levels of team click when team performance is perceived to be more successful relative to prior expectations.

2.4.1 Uncertainty and coordination in joint action

In this section, I outline evidence that substantiates a dynamical relationship between levels of uncertainty and levels of coordination—of physical movement and social communication—as functionally integrated strategies for coping with the uncertainty of joint action. This physical–social link serves as a foundation for a theory of social bonding through joint action in group exercise.

Emerging perspectives on social cognition suggest that positive perceptions of team performance in joint action and social bonding may be causally linked by an overarching mandate to reduce levels of uncertainty in joint action (Marsh et al., 2009; Friston & Frith, 2015b; Pesquita, Whitwell, & Enns, 2017). Humans are hyper-social (Tomasello et al., 2012), to the extent that our capacities for social interaction—particularly those that are more basal and implicit, like physical movement coordination—have stabilised as an often taken-for-granted aspect of our phenotypic repertoire (Wheatley & Sievers, 2016). It is important to realise, however, that successful coordination in joint action poses a cognitively improbable challenge owing to its inherent uncertainty. It appears that humans deploy a suite of canny physiological and social mechanisms in order to mitigate uncertainty in social interaction.

Uncertainty

In this thesis, I define uncertainty as a quantity that reduces an actor's

ability to successfully predict, monitor, and sustain joint action. Existing evidence suggests that uncertainty—defined in this way—can impact on cognitive processes of decision making. It has also been linked to emotional response and psychopathological disorders.

Most evidence for the effects of uncertainty on cognition comes from decision-making studies. Decision-making during uncertainty is usually defined as a situation that has limited or incalculable information about the predicted outcomes of behaviour (Huettel, 2005). In general, results suggest that higher levels of uncertainty lead to greater inability to make optimal decisions, particularly when presented with a novel or time-pressured stimulus (versus a stimulus learned through repeated exposures; Daw, Niv, & Dayan, 2005; Körding & Wolpert, 2006). Researchers have also identified the role of executive control on mitigating uncertainty in decision making (Mushtaq, Bland, & Schaefer, 2011), which is bolstered by evidence to suggest that mitigation of uncertainty via mechanisms of executive control utilises distinct neural pathways for processing uncertainty (Huettel, 2005). Taken together, this evidence suggests that processes of learning and executive control enhance ability to mitigate uncertainty in decision making.

The effect of uncertainty on physiological and emotional response is less well understood, although results generally suggest that uncertainty is associated with higher levels of stress, anxiety, and autonomic arousal. Early investigations into the effects of uncertainty on anticipation of pain (electric shocks) showed effects of higher levels of uncertainty on heart rate (Averill, Olbrich, & Lazarus, 1972) and skin conductance (Epstein & Roupelian, 1970). More recent studies have shown effects of uncertainty on hormonal (e.g., serum cortisol, see Voigt, Ziegler, Grünert-Fuchs, Bickel, & Fehm-Wolfsdorf, 1990) and immune (e.g., lymphocyte proliferation, see Zakowski, 1995) response. These studies showed that prior exposure mitigates the effects of a subsequent manipulation of uncertainty (Voigt et al., 1990), and that predictability buffers the effect of the stressor on immune function (Zakowski, 1995). Uncertainty has been associated with self-reported feelings of stress (Lazarus, DeLongis, Folkman, & Gruen, 1985), threat/challenge (Folkman & Lazarus, 1985),

and anxiety (Holaway, Heimberg, & Coles, 2006). Recently, Moutoussis et al. (2014) reported evidence of higher placebo response to (sham) pain stimulus as a function of higher uncertainty. While in the case of decision making, uncertainty appears to be mitigated by cognitive control, strategies for physiologically mitigating uncertainty are less clear. Taken together, results suggest that higher levels of uncertainty can impact on cognitive performance, emotional state, and physiological response.

With these considerations in mind, I adopt a broad and formal definition of uncertainty which draws upon the notion of Shannon entropy (Shannon & Weaver, 1963). Shannon entropy itself amounts to a cognitive (information-theoretic) rendering of thermodynamic entropy, which can be understood as a measure of our ability to predict the position of particles within a system over a duration (Linson, Clark, Ramamoorthy, & Friston, 2018). Thermodynamic entropy typically increases with heat, since faster particle movement gives off more heat than slower movement, and faster movement leads to more unpredictable positions. Instead of predicting the location of particles as a function of heat, Shannon entropy concerns predicting the location of a meaningful cognitive signal within varying levels of background noise. Higher levels of noise lead to higher levels of uncertainty, because the ways in which information can be organised to create meaning increase as the message increases (Shannon & Weaver, 1963). In other words, the greater the ability to predict where the signal is within the noise of all possibilities, the greater the certainty. Thus, in the sense here defined, higher levels of uncertainty equate to lower ability to make accurate predictions concerning meaningful information contained in the environment.

Uncertainty in joint action

Joint action is unique in its uncertainty. The uncertainty associated with coordinated physical movement in living systems was first described by neurophysiologist Nikolai Bernstein (1967). Bernstein noted that, in the case of human intra-personal movement, an impressive balance is somehow struck between flexibility, precision, and control, whereby hundreds of muscles and joints coordinate to perform many

different tasks of everyday life. When we grasp a cup or catch a ball, many individual muscles and joints—each with their individual degrees of freedom—work together in fine concert. Bernstein found it unlikely, from a computational perspective, that the central nervous system would be able to finely control all the possible movements (the degrees of freedom) of each single muscle individually to create coherently directed movements—it would be computationally impossible. Rather, he suggested that muscles and joints form “functional synergies”—flexible, function-specific, self-organising assemblies—by locally coupling and constraining each other’s degrees of freedom to greatly reduce the amount of control needed. Thus, Bernstein predicted that successful action control would necessitate dynamical mechanisms of physical movement coordination in concert with executive control functions.

The uncertainty inherent in joint action (versus individual action) poses an even greater challenge to successful performance. Intra-personal and interpersonal human movement both rely on the nervous system’s capacity to anticipate, attend, and adapt to the conditions of the environment (Keller et al., 2014). In the case of intra-personal human movement, successful coordination is made possible by the nervous system’s direct access to information concerning the spatiotemporal position of the body and its relationship to the environment. Privileged access to this information enables habituated coupling of a movement control system to the organism’s various degrees of freedom, and therefore the emergence of functional synergies (Riley et al., 2011). By contrast, interpersonal movement coordination—i.e., joint action—presents an even greater challenge. In the case of interpersonal coordination, the combination of 1) limited reliability of sensory modalities as a source of information about the action of others (Wilson & Knoblich, 2005; Wolpert et al., 2003; Frith, 2007) and 2) the informational complexity associated with a cognitive system comprising multiple autonomous agents (each with their own movement degrees of freedom) predicts that successful performance in joint action will be defined by higher levels of uncertainty relative to successful performance of actions under individual control (Turvey, 1978).

Cognitive scientist Natalie Sebanz and colleagues (Sebanz et al., 2006; Vesper et al., 2010) have proposed that joint action requires individuals to adhere to the following minimal conditions:

1. Represent a shared goal, as well as representing one's own individual contribution to the shared goal.
2. Apply monitoring and prediction processes to each partner's actions. This includes monitoring the extent to which shared goals or tasks are being fulfilled while at the same time predicting a partner's actions.
3. Facilitate continuous coordination via coordination smoothing, defined as the process of continuously improving one's prediction of the partner's action.

Considered from a dynamical perspective, the challenge associated with meeting these minimal requirements will vary as a function of the level of uncertainty in a given joint action scenario (Turvey, Fitch, & Tuller, 1982). Joint action scenarios subject to experimental analysis usually involve relatively low levels of uncertainty owing to their simplistic structure and task requirements. The synchrony and social bonding literature, for example, usually involves simple dyadic manipulations of synchrony or joint action, so that variables of interest can be successfully operationalised and manipulated (Launay et al., 2016; Mogan et al., 2017). By contrast, many real-world joint action scenarios are striking for extremely high levels of uncertainty. Real world joint action scenarios often involve many actors engaged in various hierarchically organised layers of nested joint goals over various spatiotemporal scales that, in turn, recruit various sensory modalities (Keller et al., 2014). The claim emanating from dynamical social cognition is that solving the degrees of freedom problem in joint action scenarios involving high uncertainty will require sufficiently high levels of coordination—of both physical movement and social communication between co-actors. As I continue to develop below, this claim sets a theoretical foundation for the phenomenon of team click.

Uncertainty in group exercise

Above and beyond normal day-to-day instances of communication and exchange, joint action in group exercise is defined by extremely high levels of uncertainty. Many group exercise scenarios such as group dancing or sport not only involve complex (i.e., multidimensional) joint action structures (layers, timescales, sensory modalities). Group exercise contexts also invariably involve “on-line” and “in the moment” time-pressure demands associated with action selection and execution, which could place constraints on normal cognitive function (as has been shown in laboratory studies of decision-making studies; Kerstholt, 1994; Maule, Hockey, & Bdzola, 2000). Moreover, attempts to model and predict the behaviours and intentions of multiple co-actors in joint action scenarios typical of group exercise will entail a high and possibly intractable computational burden, particularly if the number of co-actors in joint action exceeds the known cognitive upper limit for face-to-face interaction of four or five (Dunbar, 1992).² In the case of interactional team sports, the presence of *competition* between co-actors (whereby one individual or team of individuals actively attempts to foil or disrupt the actions of another individual or team of individuals; see Reimer, Park, & Hinsz, 2006) serves to amplify uncertainty in joint action to the extreme.

In addition to these heightened cognitive challenges associated with joint action in group exercise, it has also been suggested that uncertainty in group exercise will be modulated indirectly via the neurocognitive effects of physiological exertion on brain function. As Neuroscientist Arne Dietrich points out, physical exercise is at its core a stressor that will necessitate an energy trade-off in the brain, whereby energetically costly brain regions inessential to movement execution are temporarily down-regulated (Dietrich, 2004a). Neurocognitive down-regulation as a result of physiological exertion could further amplify uncertainty, by reducing individuals’

²Evolutionary Anthropologist Robin Dunbar (1992) proposes that the ratio of human neocortex size to total brain volume imposes an upper cognitive limit on real-time coordination of behaviour of approximately four to five individuals. Many interactional team sports involve five (e.g., basketball) or more (e.g., football, rugby) co-actors.

ability to predict and regulate joint action.³ Thus, it can be expected that commonly encountered aspects of group exercise—here described mainly in relation to competitive (team) sports—contain high levels of uncertainty, which will constrain usual day-to-day abilities to successfully predict, monitor, and sustain joint action.

As Bernstein pointed out in relation to individual action, it is unlikely that adherence to the minimal requirements of representing, monitoring, and sustaining joint action could be driven solely by central, executive control processes in the central nervous system—joint action would be too slow and costly (Dietrich, 2004a). It is similarly unlikely that processes of unconstrained automatic alignment (with no higher-level coordination) could enable joint action of the type observed in humans (Fusaroli et al., 2014). Rather, it seems more plausible that joint action is facilitated by a continuum of mechanisms spanning executive control through to more direct physical coupling with the environment (Semin & Cacioppo, 2008; Frith & Frith, 2008). Thus, it can be assumed that, based on the sheer uncertainty inherent in joint action (relative to individual action), successful performance will demand a suite of mechanisms—spanning both basal physical and executive cognitive domains.

Existing experimental evidence confirms the notion that physical and social processes in joint action belong to a continuum of cognitive strategies that work together to reduce uncertainty. Humans display fine-tuned sensitivity to the quality of joint action and readily infer social significance from the outcomes of joint action (Wheatley & Sievers, 2016). As early as 1944, psychologists Heider and Simmel (1944) demonstrated that complex social intensions and emotions could be deciphered from the motion trajectories of simple shapes, and individuals readily extract social information (such as gender, emotion, and personality) from dynamic point-light displays (Atkinson, Dittrich, Gemmell, & Young, 2004; Johansson, 1973). Neuroscientific evidence suggests that auditory, visual, and biological motion are processed by shared neural cortices (e.g., the right superior temporal cortex; see

³Dietrich suggests that experiences of flow and the “runner’s high” in exercise could be the result of temporary down-regulation of energetically costly brain regions inessential to movement execution (Dietrich, 2004a). As candidate brain regions, Dietrich and colleagues propose areas of the dorsolateral prefrontal cortex responsible for self-monitoring and proprioceptive sensory attenuation (commonly known as the “inner critic” regions of the brain; see Limb & Braun, 2008).

Zatorre, Chen, & Penhune, 2007; Beaucousin et al., 2006; Beauchamp & Martin, 2007). Patients with aprosodia (inability to convey or interpret dynamical properties of speech) and amusia (the inability produce or interpret music) display correlated deficits in recognising gestures and facial expressions. Taken together, these findings suggest the existence of shared neural mechanisms for multisensory perception of dynamical motion and social communication (Wheatley et al., 2012; Wheatley & Sievers, 2016), which could aid the achievement of minimal requirements of joint action described above (Novembre & Keller, 2014; Sebanz & Knoblich, 2009).

In the next section, I introduce core tenets of an emerging paradigm within social cognition that enables the formulation of a novel theory of social bonding in joint action. Foundational to this theory is the way in which higher levels of uncertainty in joint action require higher levels of physical and social coordination in order for joint action to be performed successfully. As I explain below, there is evidence to suggest that an overarching mandate of uncertainty reduction in joint action necessitates dynamical mechanisms of physical movement coordination, as well as effective and efficient mechanisms of social communication. As I develop in what remains of this chapter, this dynamical proposal sets the foundation for a relationship between perceptions of success in team performance and social bonding, mediated by the phenomenon of team click.

2.4.2 The active inference framework

An emerging body of research in cognitive science conceives of physical and social processes associated with action and perception as adhering to an overarching thermodynamic-inspired mandate of reducing uncertainty (referred to as variational or information-theoretic “free energy”; see Friston & Frith, 2015a). Now commonly referred to as the active inference framework (hereafter AIF; see Friston, Kilner, & Harrison, 2006; Friston, 2010; Clark, 2015a; Linson et al., 2018), this emerging approach enlists the neurocomputational strategy of predictive coding (hereafter PC; see Rao & Ballard, 1999) in order to operationalise the concept of uncertainty in the brain as a process of prediction error minimisation (Clark, 2013). PC posits

a dynamical and hierarchical process of “generative modelling,” in which “forward models” for prediction of action and perception are *integrated* into action and perception as the instructions for action and perception themselves (rather than being auxiliary to action and perception; Pickering & Clark, 2014). PC allows for the integration of traditionally disparate processes (e.g., physical, emotional, cognitive, or social) in one integrative inferential framework (Clark, 2015a). PC thus involves a radical inverse of traditional models of cognition and motor control. Thus far, evidence suggests that PC may offer a more computationally efficient and flexible strategy for brain function and cognitive inference than existing alternatives (Pickering & Clark, 2014; Clark, 2015b). For a more detailed review of PC and the distinction between auxiliary forward models and integrative forward models for motor control, see Appendix B.1.2.

In the PC framework, hypotheses concerning likely causes of sensory stimuli are adjudicated by the brain through an inferential process likened to “empirical Bayes” (Clark, 2013). Hierarchical predictions are informed by three calculations: 1) prior experience, 2) available sensory evidence, and 3) precision-weighting—a second-order calculation of the relative precision or reliability of the available sensory evidence. Second-order precision weighting of sensory evidence enables flexible direction of attention to prediction errors occurring at multiple levels of the hierarchical generative model (e.g. lower-order sensorimotor levels or higher-order perceptual or conceptual levels), and deriving from *exteroceptive* (relating to stimuli that are external to an organism, i.e. visual, auditory, haptic perception), *interoceptive* (relating to stimuli produced within an organism, particularly by the body’s organs (viscera) e.g., “gut feelings,” or elevated heart rate; see Seth, 2013; Feldman Barrett & Simmons, 2015), or *proprioceptive* (relating to stimuli that are produced and perceived within an organism, especially those connected with the position and movement of the body; see Friston, Mattout, & Kilner, 2011) information. Iterative learning adjusts the precision weighting mechanism to strengthen prior probability distributions of models for future inference (Robbins, 1964).

In effect, second-order Bayesian inference allows the brain to decide which prediction errors to pay attention to (e.g., exteroceptive, interoceptive, or proprioceptive) at which level of the coding hierarchy (for example, higher conceptual errors or lower sensorimotor errors; Friston & Frith, 2015a). Each error signal is conditioned with a precision weighting, which functions to either “dial-up” or “dial-down” the volume on that signal’s influence on the overall predictive model (Clark, 2015a). Precision weightings are proportional to the inverse variance of the model prior for each sensory input (Ernst & Bühlhoff, 2004; FitzGerald, Dolan, & Friston, 2014). In other words, the volume of more reliable or more commonly encountered sensory inputs will be dialled-up, while the volume on less reliable or less commonly encountered sensory inputs will be dialled-down. This process of precision weighting can be understood as the dynamical social cognition’s version of the traditional notion of attention (Ramstead et al., 2016). Bayesian precision-weighting (attention) functions by selectively promoting certain predictions over others as a strategy to reduce overall uncertainty. Here, the suggested relationship between predictability and attention also raises the possibility of its inverse, i.e., that less predictable events will lead to higher levels of surprise in instances in which less predictable events come to fruition (Chetverikov & Kristjánsson, 2016). This relationship will be considered at length below in relation to the visceral and socially agentic dimensions of team click.

As a compliment to PC, the AIF also proposes a revitalisation of affordance theory (Gibson, 1979) in order to theorise the role of extra-neural resources in enabling more effective and diverse strategies for uncertainty minimisation (Friston et al., 2012). In essence, affordances can be understood as extra-neural devices to which generative predictive models couple to reduce uncertainty. Such affordances range in their complexity, from basal affordances of the immediate physical environment, through to cultural affordances, which are coupled to more elaborate and culturally contingent processes such as language and symbolic artefacts (Ramstead et al., 2016). In the context of joint action in particular, cultural affordances can be understood as shared frames of reference that set the macro-contextual coordinates—or “hyper-priors” in PC parlance—for joint action (Clark, 2013).

Research suggests that cultural norms function as affordances that smooth coordination via a shared referent for joint action (Vesper et al., 2017). Joint actions that involve complex sequences and divisions of labour between participants appear to rely heavily on capacities to explicitly signal intention for the assigning of roles, forward planning, and repair of failed coordination (Frith & Frith, 2010). These “coordination smoothers” (Vesper et al., 2017) often function to reduce spatial and temporal variation in action by providing a shared spatiotemporal referent for co-alignment of predictions. Taken together, these proposals offer a conceptualisation of the way in which features of a specific activity or cultural context can reliably pattern and shape human experience of joint action, without necessarily altering universally shared cognitive and evolutionary principles of behaviour (Roepstorff et al., 2010). In the ethnographic sections of this thesis, I deploy the concept of cultural affordances (and related terms such as coordination smoothers) in order to render visible the various interacting processes that bear upon athlete experience of joint action in rugby in China (see Chapters 3 to 5).

To summarise, the AIF proposes that physical and social processes in joint action are linked as part of a continuum of strategies that adhere to an overarching mandate of reducing uncertainty. Traditionally-termed “lower-order” cognitive processes of physical movement regulation form the base layer of hierarchically organised predictive models, while traditionally-termed “higher-order” cognitive processes associated with executive control and communication form the higher layers of the same model. This integrated model successfully serves to reduce uncertainty (over the lifespan of the organism Ramstead et al., 2017). Thus, in the case of joint action, more successful models will be those that successfully reduce uncertainty through a coordinated assemblages of both physical and social strategies, engaging neural, extra-neural, and cultural affordances (Clark, 2015a). The AIF proposes a reconceptualisation of cognition by reconciling traditional boundaries between physical and social processes, through the suggestion of an integrated inferential framework organised in terms of uncertainty minimisation.

2.4.2.1 Was it a thief or just the wind?

To help develop an intuition for the AIF, in this section I reference a contrived example provided by cognitive scientist Giovanni Pezzulo (2014). (*I will continue to refer to this example throughout this chapter in order to simulate theoretical claims of the AIF*).

Imagine you wake up in the middle of the night to the sound of your bedroom window creaking. At the higher levels of the predictive coding architecture, competing perceptual hypotheses emerge to explain the likely causes of the sensory experience. For simplicity, assume that two plausible hypotheses emerge: 1) the wind outside caused the window to creak (wind), or 2) a thief is trying to break in to your house (thief). The probability that the sensory experience of the window creaking is due to the wind can be represented by the equation in Figure 2.1. The AIF claims that the brain formulates a probability estimate based on:

1. $P(wind)$: the model *prior* formulated by previous experience (e.g., it has been windy at night recently, or in the case of $P(thief)$, there have been some recent thefts in the neighbourhood)
2. $P(evidence|wind)$: the *likelihood* that the sensory experience is caused by the wind (this value could be informed by other sources of information, e.g., the trees outside are also rustling, the dog is not barking (which may be the case if it were a thief, ($P(evidence|thief)$))
3. Precision weighting: the reliability or certainty associated with your sensory inputs (it is dark in your room and so you may not trust your visual perception, you just woke up so could have been dreaming, etc.). The precision weight is factored into the “evidence.”

These two hypotheses (wind and thief) effectively compete on the basis of how well they explain the sensory stimuli. The brain’s capacity to quantify the uncertainty of any given sensory state facilitates optimal selection between competing predictions pertaining to the same bottom-up sensory signals. In this example, based

$$P(\text{wind}|\text{evidence}) = \left\{ \frac{P(\text{wind})P(\text{evidence}|\text{wind})}{P(\text{wind})P(\text{evidence}|\text{wind}) + P(\text{thief})P(\text{evidence}|\text{thief})} \right\}$$

Figure 2.1: Bayesian model for the prediction of wind as the cause of the window creaking. Source: Pezzulo (2014)

on the priors ($P(\text{wind}) = .8$ (it has been windy recently) and $P(\text{thief}) = .2$ (no recent reports of theft)), and the (precision-weighted) evidence ($P(\text{evidence}|\text{wind}) = .6$ and $P(\text{evidence}|\text{thief}) = .5$ (roughly equivalent because it is dark and you have just woken up), the probability of wind ($= .83$) is much higher than the probability of thief ($= .17$). In this case, the prediction that wind caused the window to creak wins out, and guides action and perception accordingly (e.g., you decide to go back to sleep).

The “active” quality of the AIF refers to its ability to integrate a range of sensory inputs into one overarching inferential process. Original models of PC dealt primarily with exteroceptive information (relating to stimuli that are external to an organism, i.e. visual, auditory, haptic perception; Rao & Ballard, 1999; Friston, 2010). In the wind vs. thief model considered above, for example, only exteroceptive evidence is considered, in the form of the auditory stimulus of the window creaking. Research has since demonstrated that the PC approach can also account for “proprioceptive” information (relating to stimuli that are produced and perceived within an organism, especially those connected with the position and movement of the body), as well as “interoceptive” information (relating to stimuli produced within an organism, particularly by the body’s organs (viscera) e.g., “gut feelings,” or elevated heart rate; see Seth, 2013; Feldman Barrett & Simmons, 2015). Incorporating proprioceptive and interoceptive information sources into PC allows researchers to theoretically demonstrate that human cognition is both “embodied”—inference is rooted in and contingent upon visceral, interoceptive information (Pezzulo, 2014), as well as “active”—in the sense that humans can rely on physical movement to reduce

the discrepancy between proprioceptive predictions and actual body states, and thereby reduce uncertainty (see Friston, 2010; Clark, 2015a). In the case of motor systems, agents like humans are able to move their sensors in ways that amount to actively seeking or generating the sensory consequences that they (or rather, their generative models) expect (Friston, 2003, p. 1349).

To fully comprehend this proposal, consider an active revision of the wind vs. thief example. Two key differences in the model become apparent. First, the evidence that the generative model considers is broadened to include both interoceptive and proprioceptive information, in addition to exteroceptive evidence. Assume that before you went to bed you just watched a horror movie, and when you woke up to the sound of a window creaking, your heart began to pound, and you immediately fixated on the hypothesis that a thief was causing your window to creak. Immediate fixation on the thief hypothesis can be explained by the contribution of interoceptive information (e.g., autonomic stress response, heart beat, etc.) to the sensory evidence (Pezzulo, 2014). In addition, the incorporation of proprioceptive information into the model (for example, the possibility of moving to turn on the bedside lamp) creates additional cognitive affordances through which higher-level predictions could be strengthened (or uncertainty can be minimised). This difference in the model demonstrates how perception, emotion, and action are functionally integrated in human cognition under the AIF.

Second, broadening sensory inputs in the model also introduces the problem of differential reliability of sensory inputs. The wind vs. thief example describes a situation in which exteroceptive information is relatively unreliable: it is dark, so visual inputs are restricted, and what you heard is unreliable because you just woke up, and maybe it was part of a dream. By contrast, interoceptive information is usually quite certain: you—or your nervous system—can be certain that your heart is pounding and that you feel unnerved by virtue of direct access to these sensations. In this particular case, interoceptive inputs may have a greater influence on the overall inference due to their reliability. As explained above, evidence suggests that the brain deals with multiple sensory inputs via a process of “Bayesian multisensory

integration” (Ernst & Bühlhoff, 2004), with the reliability of each sensory input is precision-weighted proportional to the inverse of its variance. In the wind vs. thief example, the interoceptive information from your body will be precision-weighted as the most reliable source, and will likely tip the balance of the model to favour the hypothesis that a thief caused the window to creak. If this is indeed the case, and you fixate on the thief hypothesis, you will move your body in a way so as to reconcile the discrepancy between proprioceptive predictions that also correspond to the thief hypothesis (and therefore also tuned to a higher volume in the model). The result of this trajectory of action and perception may be that you act by turning on your bedside lamp (Pezzulo, 2014).

This example shows that predictions are formulated based on a combination of prior probability and in-the-moment reliability of multiple sensory inputs. Following this line of reasoning advanced by the AIF, it is possible that, in joint action scenarios typical of group exercise, the likelihood of successful team performance will be set to low, while the volume of interoceptive information will be dialled up. To my knowledge, this proposal has yet to be tested empirically. As I explain in more detail below, this possible scenario may have implications for experiences of viscerality, social agency, and expectation violation in instances in which team performance is successful.

2.4.3 Successful performance in joint action is facilitated by a link between dynamical coordination of physical movement and social communication

The AIF predicts that successful performance in joint action will entail the flexible deployment of various hierarchically organised cognitive strategies designed to reduce uncertainty. In particular, evidence suggests that, in joint action scenarios defined by higher uncertainty, more successful coordination of physical movement could set a sensorimotor foundation for more coordinated social communication, and vice versa (Wheatley & Sievers, 2016). Here, I argue that the implication of this line of research is that, under conditions of higher uncertainty in joint

action, higher levels of successful performance should facilitate higher levels of social connection, i.e., social bonding.

Successful performance in joint action is associated with functional interpersonal synergies and action-perception coupling

In this section, I outline evidence for coordination of physical movement in uncertain joint action scenarios as a basis for social connection. “Functional synergies” are known to exist on multiple levels of human behaviour, from brain function (Yufik, 1998; Sengupta, Stemmler, & Friston, 2013; Kelso, Dumas, & Tognoli, 2013), to interpersonal interactions (Kelso, 2009; Riley et al., 2011; Fusaroli et al., 2014), to large-scale human societal dynamics (Nowak, Vallacher, Zochowski, & Rychwalska, 2017). This cross-sectional evidence for coordination in complex human systems—from brains to large-scale societies—suggests that synergies can serve as effective and adaptive solutions to uncertainty inherent in multi-component or multi-agent interactions across multiple biological timescales (Nowak et al., 2017).

There is evidence to suggest that functional synergies in joint action (“functional interpersonal synergies,” hereafter FIS; Riley et al., 2011)) facilitate successful performance by reducing uncertainty and facilitating social communication in joint action. In joint action, FIS are defined by instances in which movement degrees of freedom of a multi-component system couple together to 1) reduce (or “compress”) the number of overall dimensions of the system and 2) increase reciprocal compensation (the ability of one component of a synergy to react to changes in others; see Riley et al., 2011). Evidence supports the existence of FIS in real-world joint action tasks, ranging from ensemble music performance (Keller, Pecenka, Fairhurst, & Repp, 2012; Miyata, Varlet, Miura, Kudo, & Keller, 2017), to dancing (Chauvigne, 2017), to martial arts (Schmidt, Morr, Fitzpatrick, & Richardson, 2012), to team sports (Duarte, Arajo, Correia, & Davids, 2012; Passos, Fonseca, Davids, Gouveia, & Ara, 2014).⁴ This evidence suggests that FIS may facilitate

⁴In these studies, specific component degrees of freedom are modelled as coupled oscillators (using the HKB model, which describes the change in the relative phase between two oscillatory components. See Haken, 1985; Kelso, Saltzman, & Tuller, 1986). Models are analysed for non-random fluctuations in relative phase over multiple time scales. This type of synchronisation

processes of prediction, monitoring, and communicating in joint action.

The suggestion that higher levels of successful performance in joint action is aided by higher levels of coordination of physical movement is supported by research showing direct action-perception links between co-actors in technically complex joint action scenarios (Novembre & Keller, 2014). Parallel strands of research in psychology (Prinz, 1990, 1997, 2013), neurophysiology (Rizzolatti & Craighero, 2004; Rizzolatti & Fabbri-Destro, 2010), and neurocognition (Wolpert & Kawato, 1998; Wolpert & Ghahramani, 2000) indicate that interpersonal behavioural coordination in joint action is facilitated by the intrinsic coupling of action perception and action execution in the human brain. Action perception links refer to the representation of a perceptual effect (say the sound of a middle-C on a piano) can trigger the movement necessary to produce the effect itself (motor instructions for playing the middle-C key on a piano).

Importantly, evidence suggests that sensory-motor coupling emerges primarily as a result of motor learning. Having only visual (Candidi, Sacheli, Mega, & Aglioti, 2014) or auditory (Lahav, Saltzman, & Schlaug, 2007) experience with a given action is not sufficient to trigger motor responses—active motor learning is necessary. As such, most research into action-perception coupling occurs with individuals who have mastered a certain sensorimotor task, such as expert musicians, whose movements and intended sounds become strongly associated (Novembre & Keller, 2014). Evidence suggests that action-perception links may play an important role in on-line prediction (Maidhof, Rieger, Prinz, & Koelsch, 2009; Ruiz, Jabusch, & Altenmüller, 2009) and execution (Drost, Rieger, Brass, Gunter, & Prinz, 2005; Keller, Dalla Bella, & Koch, 2010) of technically complex actions.

Accordingly, a similar proposal exists for the function of action-perception links in joint action. Specifically, experimental evidence suggests that action perception links between co-actors enhance online prediction and execution of joint actions through a process of co-representation (Novembre & Keller, 2014). Action-perception links are associated with monitoring and integrating (e.g., timing or combined pitches)

is said to be of a fractal or semi-fractal organisation, also known as 1/f scaling or “pink noise” (Caron, Coey, Dhaim, & Schmidt, 2017).

the actions of other ensemble members with self-generated actions (Loehr, Kourtis, Vesper, Sebanz, & Knoblich, 2013), and these effects appear to be stronger in individuals with high perspective-taking skills (Novembre, Ticini, Schütz-Bosbach, & Keller, 2012; Loehr et al., 2013)—suggesting the possibility that individual differences in dispositions towards movement coordination or personality types may modulate abilities to establish, monitor, and sustain joint action (Marsh et al., 2009; Keller et al., 2012). Studies of highly skilled practitioners in joint action demonstrate that more technically competent practitioners generate more accurate predictive models for joint action than less technically competent practitioners (Tomeo, Cesari, Aglioti, & Urgesi, 2012; Aglioti, Cesari, Romani, & Urgesi, 2008; Mulligan, Lohse, & Hodges, 2016). In studies involving skilled versus non-skilled practitioners in dyadic interactions, it has been shown that more skilled practitioners create stronger dynamical coupling through flexibly modulating their actions with others (Schmidt, Fitzpatrick, Caron, & Mergeche, 2011; Caron et al., 2017). These findings are corroborated by other studies that find that professional footballers (versus novice controls) are able to more accurately predict the direction of a kick from another player’s body kinematics (Tomeo et al., 2012, see also Aglioti et al., 2008; Mulligan et al., 2016 for similar results with basketball and dart players).

The overlap between mechanisms for action production and action observation suggests that individuals may represent their own and others’ actions in a commensurable format. Training-induced motoric representation of self and other actions may thus facilitate various capacities important for joint action, such as prediction, adaptation, and entrainment (Novembre & Keller, 2014). Action-perception coupling can be regarded as a basic link between sender and receiver that provides procedural, perceptual, and emotional common ground between individuals (Rizzolatti & Fadiga, 1998). Considered from a dynamical perspective, extensive evidence for action-perception links confirms the predominance of dynamical coordination of physical movement in scenarios involving highly complex—and therefore highly uncertain—joint action.

FIS and action-perception links facilitate social communication

Evidence suggests that, in addition to enhanced processes of action execution and prediction in joint action, higher levels of dynamical coordination of physical movement facilitate more elaborate forms of social communication, including 1) attributions of agency to self and others, 2) evaluation of performance of self and others, and 3) utilisation of cultural affordances as coordination smoothers in joint action. Considered from the perspective of the AIF, these social processes can be understood as heuristics that function to make the computational complexity of joint action more tractable (Moutoussis et al., 2014).

An accumulation of evidence suggests that action-perception links facilitate accurate attribution of agency, which refers to the feeling of control (attributed to self, other, and/or group) over actions and their consequences (Moore, 2016). Evidence suggests that co-actors generate internal models of self and other either spontaneously and involuntarily—as in the commonly used social simon task experimental paradigm (Sebanz, Knoblich, & Prinz, 2003; Atmaca, Sebanz, Prinz, & Knoblich, 2008)—or more deliberately—as in a coordinated dyadic horizontal jumping task (Vesper, van der Wel, Knoblich, & Sebanz, 2012). The perception of agency in joint action can be understood as a social inferential process—with roots in sensorimotor (physical) processes that enables the delineation of roles in joint action and effective routing of sensory information for action prediction and execution (Sato, 2008; Friston & Frith, 2015a; Kelso, 2016). Experimental evidence has shown that FIS facilitate performance of social cognitive or linguistic tasks, such as gaze coordination and turn taking in conversation (Miles, Nind, Henderson, & Macrae, 2010; Richardson & Dale, 2005; Shockley, Richardson, & Dale, 2009). This evidence suggests that FIS will play a role in enabling accurate processes of sensory routing of contributions of self and other to joint action. Evidence also suggests that movement signatures characteristic of functional interpersonal synergies may be related to the perception of being “in the zone” with a co-actor (Noy, Dekel, & Alon, 2011; Noy et al., 2015; Hart, Noy, Feniger-Schaal, Mayo, & Alon, 2014), or the transcendental experience of a “we” mode of social cognition in which distinctions

between self and other are blurred (Gallotti & Frith, 2013). Studies also show that the capacity for co-representation of self and other action plans is modulated by mood (positive or negative affect, see Kuhbandner, Pekrun, & Maier, 2010), self-concept and social orientation (Colzato, Zech, et al., 2012; Colzato, de Bruijn, & Hommel, 2012), and processes of group membership (de Bruijn, Miedl, & Bekkering, 2008; Aquino et al., 2015). Together, this area of research supports an association between coordination of physical movement and coordination of social agency.

Beyond agency, research also suggests a connection between coordination of physical movement and the performance of “type-based” social evaluations of self and others as a mechanism through which to reduce high levels of uncertainty in joint action (Moutoussis, Bentall, El-Deredy, & Dayan, 2011; Moutoussis et al., 2014). It is well established in psychology that people automatically prescribe beliefs and traits to self, other, and the target social group based on 1) perceived social outcomes of joint action (e.g., “success” or “failure”), 2) perceived capabilities in joint action (e.g., “weak” or “talented”) and 3) perceived preferences for acting (e.g., “good,” “fair,” or “trustworthy”; Bem, 1967; Fowler et al., 2006). Clinical interpretations of this line of research have suggested a functional role for self-representation (i.e., self-esteem) as an indicator of one’s likely social evaluation by the social milieu (Leary, Tambor, Terdal, & Downs, 1995). From the perspective of the AIF, self evaluations of this nature function as useful heuristics that serve to drastically reduce the computational burden associated with prediction of movement coordination in joint action (Moutoussis et al., 2011). In essence, by type-casting the self and others and basing predictions for joint action on such tasks, the daunting computational challenge of movement coordination in joint action becomes more tractable.

Conversely, an inability to generate functional perceptions of agency and type-based evaluations has been associated with mental health disorders such as ASL (Friston & Frith, 2015a), schizophrenia (Frith, 2007), and depression (Moutoussis et al., 2011). In addition, it has been demonstrated that being psychologically distanced from another individual can inhibit the emergence of interpersonal synergies (Miles et al., 2010). Thus, enhanced coordination may be a source

of enhanced communication, and both of these combine to reduce uncertainty in joint action and facilitate successful performance.

In addition to attribution of agency and type-based evaluations of self and others, it is also possible that higher levels of coordination of physical movement generate higher levels of social coherence around shared communication systems. In the context of joint action in particular, cultural conventions can be understood as shared frames of reference that set the macro-contextual coordinates for joint action (Clark, 2013). Joint actions that involve complex sequences and divisions of labour between participants appear to rely heavily on capacities to explicitly signal intention for the assigning of roles, forward planning, and repair of failed coordination (Frith & Frith, 2010). These smoothers of coordination appear to function by reducing spatial and temporal variation in action and by providing a shared spatiotemporal referent for co-alignment of predictions.

Depending on the context of the joint action, it could be subject to pre-existing, mutually recognised power relations typical in the established culture (e.g., favouring hierarchical or egalitarian communication, see Cheon et al., 2011)) and the particular situational context (e.g., formal or informal). Establishing roles, such as leader or follower, also has a similar smoothing effect, and often the affordances in the task environment shape the smoothing strategies available to co-actors (Marsh et al., 2009). In sum, the AIF predicts that coupling of lower levels of generative models, via mechanisms of FIS and action perception links, will facilitate reinforcement of higher levels of the same models. Higher levels include processes more commonly associated with social communication, such as attributing agency, making type-based evaluations of self and others, and utilising shared cultural affordances as heuristics for computationally tractable performance in joint action.

Summary of the link between uncertainty and coordination in joint action

Here I have reviewed evidence to suggest that an observable link between perceptions of successful team performance and social bonding in group exercise could be

productively understood from the perspective of uncertainty. The emerging AIF suggests that instances of dynamical coordination of physical movement—such as those identified in FIS and action-perception links between skilful practitioners—and processes of social communication—including attributions of agency and performance evaluations of self and others, and mutual recognition of shared cultural affordances—are functionally connected by an overarching mandate to minimise uncertainty in exchanges with the environment. In this conception, mechanisms that facilitate successful physical strategies of coordination will also facilitate successful social strategies of communication, and vice-versa. In effect, physical and social mechanisms work together to help manage high levels of uncertainty inherent in joint action (relative to individual action). Various strands of existing empirical research support this line of reasoning, while many proposals generated by the AIF have yet to be empirically tested (Pickering & Clark, 2014; Clark, 2015a).

The implication that flows from this body of work is that, in joint action scenarios involving higher uncertainty, more successful perceptions of performance could generate higher perceptions of social bonding (see Figure 2.2). As I discuss in the following section, team click may be a necessary mediatory phenomenon in this process. The visceral and socially agentic experience of team click may offer the crucial ingredients conducive to more elaborate and culturally contingent processes characteristic of social bonding. Next, I turn to the experiential dimensions of team click and their possible mechanistic underpinnings.

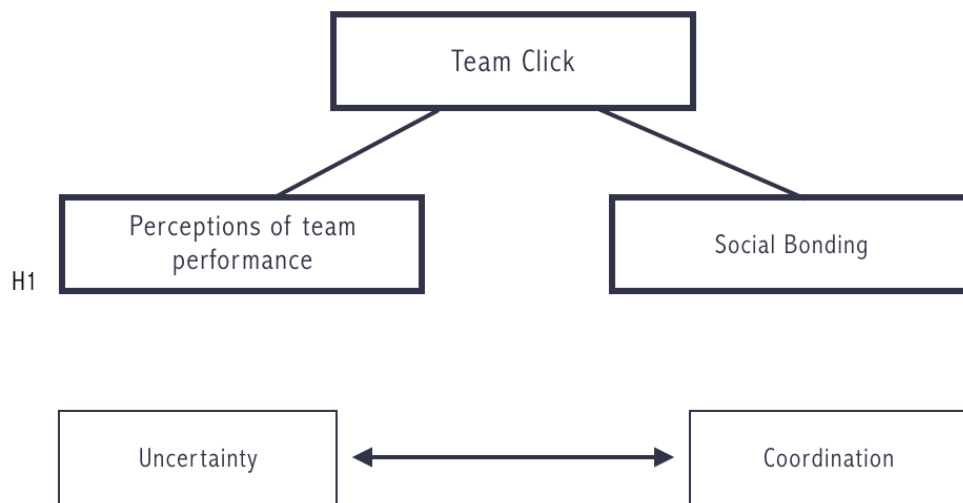


Figure 2.2: A relationship between performance, team click, and social bonding (H1) arises from a theoretical foundation of uncertainty and coordination in joint action.

2.4.4 Theoretical substantiation for the visceral and socially agentic foundations of team click

Having outlined the theory discussed above, I can now formulate two core claims of the general account of team click in group exercise. The first claim is that perceptions of successful team performance are associated with perceptions characteristic of team click, namely, viscosity and social agency. The second claim, in turn, is that these same perceptions provide a foundation for higher-order communicative processes characteristic of social bonding.

In addition to these two core claims, I identify positive violation of expectations concerning team performance as a potential mechanism for explaining the link between uncertainty, perceptions of team performance, and team click. According to the predictions of the AIF, when uncertainty in joint action is high—as it invariably is in group exercise contexts—expectations concerning successful team performance will be inherently low, which will result in more positive expectations of violations concerning team performance when performance is deemed to be successful. More heightened and positively-valenced attention to team performance

resulting from more positive violations of expectations could serve as an precedent for team click and, in turn, social bonding.

2.4.4.1 Positive perceptions of team performance are associated with experiences of viscosity and social agency

The empirical evidence and sporting anecdote mentioned above indicate that team click is associated with an experience of social agency. Social agency may refer to a situation in which the distinction between individual and other agency is blurred, or in which individuals feel that their individual agency is extended by the abilities of others. What's more, agentic experiences may also be accompanied by a perception that self and others will reliably contribute to successful team performance. In addition, team click is associated with perceptions of tacit understanding between teammates, or an atmosphere or aura surrounding the team. Athletes may also experience team performance action as flowing and coherent. In this section, I review evidence for cognitive mechanisms capable of accounting for these socially agentic and visceral dimensions to the experience of team click.

In brief, evidence suggests that experiences of social agency and viscosity associated with evaluations of performance can be explained in terms of how uncertainty in joint action affects processes of sensory attenuation and integration. Uncertainty in joint action appears to impact individuals' ability to optimally integrate sensory information deriving from the actions of others and the external environment, which has consequences for processes such as attribution of agency and evaluations of the performance of self and others in joint action.

Uncertainty of team performance is associated with attributions of social agency

Existing empirical evidence suggests an inverse relationship between uncertainty in joint action and attributions of agency, such that more predictable action affords more reliable and accurate attributions of agency. Research has shown that agency in action is strongly correlated with an individual's ability to anticipate individual contribution to action. For example, Sato (2008) and colleagues demonstrated that

a discrepancy between prediction and sensory input can alter the experience of agency: unpredicted sensory input can lead to ascribing agency for that input to an external source, for example, other participants in joint action or the external environment (Sato & Yasuda, 2005; Frith, 2007). It is generally understood that this result can be explained by sensory attenuation that reliably occurs when individuals anticipate action.

Research has shown a strong correlation between attenuation of proprioception (predictions relating to individual contribution to action) and experiences of self agency (Wolpert et al., 2003; Sato, 2008), as well as an inverse correlation between sensory attenuation and ascribing agency to sources external to the self (Brown, Adams, Parees, Edwards, & Friston, 2013). As has been well documented in the case of schizophrenia, attribution of agency in social interaction may be modulated by individual variation in “locus of control” (the degree to which events are perceived to result from one’s own actions or not), and this may be related to improper function of the parietal cortex (Frith, Blakemore, & Wolpert, 2000). Here, individual variation in dispositions for social interaction appears to be important to perceptions of agency in joint action. More fundamentally, agency appears to be functionally tethered to uncertainty (Frith, 2007).

Research addressing the question of how people experience agency or other social inferences in actions they intentionally produce in coordination with others (joint agency) is less abundant (but see van der Wel et al., 2012; van der Wel & Knoblich, 2013). Based on experimental evidence, van der Wel et al. (2012) argue that *consistency* between action and the original intention may be the most important condition for attribution of agency in joint action. The authors present results of a study in which perceptions of self agency do not decrease when an individual transfers from performing a solo action to performing the same action with a partner. Individuals do, however, experience a boost in agency when they transfer from performing a joint action to the same action solo, suggesting that this transfer may induce enhanced consistency owing to the greater reliability of predictions pertaining to action that is individually controlled (van der Wel et al., 2012). To my knowledge

at the time of writing, no research has directly addressed the question of how individuals experience a boost in agency resulting from unexpected contributions of *others* to successful performance in joint action. The question surrounding perceptions of unexpected shared agency demands further empirical investigation.

Drawing upon the proposed relationship between uncertainty and attribution of agency, it is possible that more uncertain performance outcomes in joint action will facilitate attributions of higher levels of agency to sources external to the self when more uncertain performance outcomes come to fruition (Sato & Yasuda, 2005). Due to the uncertainty inherent in joint action characteristic of group exercise, it can be expected that individuals will face difficulties accurately modelling the contributions of others (and self) to joint action, and thus the probability of predictions concerning successful team performance will be low. Subsequently, Bayesian second-order precision-weighting will function to “dial-down” the volume of prediction errors deriving from team performance. In instances in which team performance is, in fact, successful, the unexpected nature of this occurrence could generate attributions of agency to teammates or the team as a collective.

I address the mechanism of expectation violation in joint action in more detail below, but it is worth noting here that positive expectation of violation concerning team performance could play an important role as a preceding mechanism to the experience of social agency in joint action. The experience of successful team performance could therefore result in positive violations of prior expectations (set to low owing to the high uncertainty of joint action success). As I explain in the next section, positive expectation violation concerning team performance also appears to be relevant to proposals concerning the experience of viscosity in joint action.

Uncertainty of team performance is associated with perceptions of viscosity

The AIF predicts that experiences of viscosity associated with successful team performance (such as experiences of tacit understanding, team aura, and flow) will arise when sensory information with which to perceive team performance is

restricted to interoceptive (as opposed to exteroceptive) inputs (Pezzulo, 2014). As discussed above, the uncertainty of dynamic joint action scenarios often involves constraints on the availability of sensory information, particularly concerning the actions and intentions of others (Wolpert et al., 2003). According to the theory of Bayesian multisensory integration (Ernst & Bühlhoff, 2004), it can be expected that individuals engaged in joint action will dial-down the volume on prediction errors pertaining to exteroceptive inputs (e.g., the contributions of others to team performance) and dial-up the volume of interoceptive and proprioceptive inputs (those most reliable in an otherwise uncertain terrain of sensory inputs).

The relationship between perceptions of successful team performance and viscerality can be best explained through a return to the wind vs. thief example mentioned above. In some respects, waking up in a dark room in the middle of the night is not too dissimilar to taking the rugby field: exteroceptive information will be less reliable than information generated internally, via interoceptive and proprioceptive inputs (Pezzulo, 2014). As such, it could be predicted that the contribution of interoceptive and proprioceptive inputs to the total “evidence” will be weighted more reliable than exteroceptive inputs (see 2.4.2.1).

Moreover, consider that group exercise requires constant execution of movement, contemporaneous with the movement of others. As discussed above, movement requires the attenuation of proprioceptive information (so as not to interrupt the flow of movement itself, see Dietrich, 2004b). Thus, it can be predicted that the volume on proprioceptive error signals will at times be turned down low, at least while participants are executing movement (Friston & Frith, 2015a).⁵ There may need to be some optimal tradeoff here, in which the volume is not turned down too low, so as to keep track of the movements of others while moving oneself (Pesquita et al., 2017). In this situation, with the combination of volume on exteroceptive information turned down low, and proprioceptive inputs attenuated to allow for movement, interoceptive inputs could enjoy the most precision of all available sensory sources,

⁵Hearing your own voice on a Skype call is an intuitive example of the way in which proprioception can interrupt the flow of action. In this case, usually attenuated proprioception is unwittingly fed-back to the speaker.

and therefore have a strong bearing over resulting cognitive inferences. Interoceptive information could therefore provide an embodied grounding for feelings of viscosity in joint action, and the mysterious “gut feel” of team click.

The key point in this case is the role of second-order processes of sensory integration, which function to flexibly incorporate and finesse sensory inputs in order to formulate perception and experience. Considered from a dynamical perspective, the visceral feeling associated with team click may be crucially contingent on these second-order processes of attention. In essence, in group exercise environments in which uncertainty is high, the most reliable information with which to model environment will be interoceptive more so than exteroceptive (or proprioceptive).

2.4.4.2 Potential preceding mechanism to team click: Positive violation of expectations concerning team performance

There is evidence to suggest that expectation violation could be an important precedent to click. This seems particularly likely in light of how violations of expectation appear to function as feedback signals capable of directing attention.

It is now well understood in cognitive neuroscience that positive and negative affect associated with prediction errors (expectation violations) function as important mechanisms in the regulation of behaviour (Pessiglione, Seymour, Flandin, Dolan, & Frith, 2006; Haggard, 2008). There is evidence to suggest that affect serves as feedback for prediction errors. Cortical processes of prediction error management appear to be mediated by the activity of the dopaminergic system (Schultz, 2016; Friston et al., 2012), while subcortical neuromodulatory systems, such as those responsible for producing norepinephrine, acetylcholine, and endogenous opioids, appear to be involved in attuning cortical processing to signals from the body and environment that are important for survival (Lewis, 2005). There is now evidence to suggest that complex cognitive processes (traditionally understood to be confined to cortical regions) and subcortical neuromodulatory systems (traditionally understood to be responsible only for affective response and exogenous to the brain’s inferential processes) work in a loop of reciprocal interaction in order to enhance processes of error management (Damasio, 1994; Lewis, 2005; Miller & Clark, 2017; Barrett, 2017).

It is generally assumed that affective feedback following prediction errors should strike a neuroeconomic balance between rewarding and encouraging exploitation of accurate predictions, and exploring novel environments of uncertainty (Chetverikov, 2014). Recently, Chetverikov and Kristjánsson (2016) have proposed a model for affective feedback in the AIF, in which affective feedback is weighted with the inverse prior probability of the prediction, so that more probable predictions on balance receive *less* positive feedback. In other words, confirmation of more probable predictions yields less positive feedback than confirmed less probable predictions. By contrast, less likely outcomes will be weighted with higher affective reward. In this proposal, the authors suggest that the AIF serves to incentivise exploration of novel free energy deposits, and not just exploit exiting reliable predictions (thus proposing a dynamical solution to the “dark room dilemma” associated with traditional (non-dynamical) models theories of prediction error management; Friston et al., 2012).

In the wind vs. thief example, in which $p(\text{thief}) = .2$ and $p(\text{wind}) = .8$, the level of surprise attributed to the confirmation of the thief hypothesis would be .8 (whereas the wind hypothesis would be only .2). In this case, however, the surprise associated with encountering a thief would likely not be experienced as pleasant. In the case of team click, by contrast, the reward associated with successful joint action appears to be positively valenced surprise. As already mentioned, it is likely that the lower probability of team performance success in joint action could generate relatively high levels of positive affective feedback when team performance is perceived to be successful. To offer an extended interpretation of the joint agency study conducted by van der Well and colleagues (2012), it is possible that individuals experienced a boost in individual agency over action owing to more positive violations concerning individual performance in action relative to prior expectations for action control (developed in the previous task in the experiment, in which their control over action was shared with another participant; van der Wel et al., 2012, p. 1277).

2.4.4.3 Theoretical substantiation for the social bonding effects of team click

Social bonding in joint action includes perceptions of emotional support (Wheatley et al., 2012), a common goal (see Dunbar, 2012; Wolf, Launay, & Dunbar, 2016), and shared social identity between co-actors (Whitehouse, McQuinn, Buhrmester, & Swann, 2014). Considered from a dynamical perspective, the relationship between team click and social bonding can be explained in terms of the tethering of physical and social cognitions via hierarchical generative architecture of the AIF. In brief, the bonding effects of team click may relate to processes whereby viscerality and social agency become associated with more elaborate and culturally contingent cognitions characteristic of social bonding. As with the link between joint action and team click, the link between team click and social bonding is driven by the overarching mandate of uncertainty minimisation.

As outlined above, team click is a phenomenon generated by bodies and brains in motion, which directs attention to interoceptive and lower order prediction errors during joint action. The AIF proposes that lower level sensorimotor processes are tethered to higher-order cognitions via an hierarchical generative architecture (Ramstead et al., 2016). In this proposal, higher-order cultural affordances couple with lower level sensorimotor processes in order to reduce overall uncertainty by explaining away lower order perceptions. Pezzulo invokes fear-driven belief in a bogeyman as an example of this phenomenon at work:

You quite literally recognise a bogeyman with your body, and with your fear in particular. As a consequence, the bogeyman idea is a form of *self-fulfilling prophecy*, because a terrified child can take his or her terror as evidence that the bogeyman exists (and is probably close), and the terror itself can increase due to the circular causality [of active inference] (Pezzulo, 2014, p. 909)

Here, the bogeyman functions as an affordance enlisted to “explain away” aversive or unexpected lower level sensorimotor experiences. In the same sense that there is no material evidence for the bogeyman (or a universal moralising high god, for example), team click does not exist as a concrete object that an athlete can see or touch when

off-line and off the field. Instead, concepts such as tacit understanding, group flow, and team atmosphere are all examples of culturally-mediated concepts which serve to rationalise what are ultimately largely inaccessible and mysterious processes of movement regulation and coordination to which individuals have very little direct or privileged access (for ethnographic evidence of team as an ineffable phenomenon, and the automatic nature in which athletes ascribe social explanations to team click, see Chapter 5.2.2). In essence, the combination of visceral and agentic experiences of team click, and coherence of these perceptions with complimentary communicative processes—e.g., a shared system of language or cultural artefacts, may give rise to a visceral and agentic sense of connection to others or to group identity.

This proposal echoes the definition of the validated social psychological construct of “Identity Fusion” (hereafter Fusion; Swann, Gómez, Seyle, Morales, & Huici, 2009). Fusion entails a form of group membership defined by a “visceral sense of oneness with the group,” whereby the personal self is fused in a 1:1 relationship with the social group. In a study investigating the relationship between autonomic arousal and fusion, Swann and colleagues found that raising the autonomic arousal of participants through exercise increased endorsement of extreme actions for, and charitable donations to Spain (the target group with which participants were fused; see Swann, Gómez, Dovidio, Hart, & Jetten, 2010, p. 839). Importantly, manipulating physiological arousal (measured by heart rate) did not lead to endorsement of costly behaviour among individuals who were merely identified (and not fused) with Spain. In subsequent analyses, the authors show that a relationship between fusion and arousal is partially mediated by personal agency (Swann, Gómez, Dovidio, et al., 2010, p. 824). In this study, autonomic arousal is responsible for heightened feelings of personal agency towards Spain, which in turn leads to greater willingness to endorse and perform self-sacrificial acts on behalf of Spain. The role of the “agentic” personal self” in processes of identity fusion has since been emphasised as a key principle that distinguishes fusion from group identification, in which the self gives way to prototypical group behaviour (Gómez et al., 2011). This study also helps affirm another central principle of fusion, namely the “identity synergy

principle,” which states that exciting personal agency (in the form of physiological arousal) activates group-level agency, owing to the fact the individual and the group are psychologically one and the same thing (Swann & Buhrmester, 2015). In this sense, commitment to the group (Spain) is analogous to commitment to the self, and when self-agency is activated physiologically, agency on behalf of the group is activated psychologically.

Considered in the context of the proposals for social cognition outlined in this chapter, this study captures the relationship between physical and social coordination in group exercise. While the mechanisms tested in this study do not pertain directly to uncertainty in joint action, they do suggest an alignment between viscerality, social agency, and group membership—a finding that is consistent with the predictions of the AIF and potentially commensurate with a general account of team click in group exercise.

2.5 Research hypotheses

In response to research questions set out in Chapter 1, in this chapter I reviewed empirical and theoretical evidence for a general account of team click in group exercise. The claims of this account are grounded in a dynamical theory of social cognition—known as the active inference framework—which proposes a relationship between coordination of physical movement and social communication driven by an overarching mandate to reduce information theoretic uncertainty in joint action.

The tenets of the AIF, including PC and cultural affordances, offer mechanistic explanations for how positive perceptions of team performance can lead to social bonding. Joint action typical of group exercise contexts reliably generates high levels of uncertainty, which serves to modulate and constrain usual processes of prediction and multisensory integration of action and perception. Theory suggests that positive violations of expectations may be a key mechanism in a relationship between uncertainty, team click, and social bonding: higher levels of uncertainty surrounding team performance should lead to lower expectations of team performance success. Thus, when team performance is more successful, expectations should be more

positively violated. The affective reward and surprise associated with positive expectation violation may serve to direct attention towards the perceptions which will demand, in turn, the recruitment of social strategies of communication—ranging from ascribing agency, performing type-based characterisations, or subscribing to collective representational affordances—in order to explain away the mysterious source of their (unexpected) emergence.

Based on these considerations, I propose hypotheses designed to test the two main research questions on which I focus attention in this thesis (see Table 2.2). First, I seek to test an empirically and theoretically motivated relationship between joint action, team click, and social bonding (Research Question 1, see 1.5.1). Specifically, I hypothesise that team click will mediate a positive relationship between perceptions of team performance and social bonding (H1). This claim is supported by two sub-hypotheses, that more positive perceptions of success in team performance will generate higher levels of team click (H1a), and that higher levels of team click will lead to higher levels of social bonding (H1b).

Second, I seek to test the possible mechanisms that underwrite team click in group exercise (Research Question 2). Based on an assessment of relevant theoretical literature, I hypothesise that better-than-expected execution of joint action will mediate a relationship between prior levels of uncertainty and team click (H2). In more straightforward terms, I expect that higher levels of uncertainty in joint action will predict lower levels of expectations for joint action success (H2a) and, in turn, higher levels of positive expectation violation when team performance is unexpectedly successful (H2b). In the following chapters of this thesis, I situate, assess, and test these hypotheses in the research setting of rugby in China.

Table 2.2: Hypotheses for a general account of team click in group exercise

Core Hypothesis (H1): Team click will mediate a relationship between perceptions of success in team performance and social bonding. Specifically:	
<i>H1a</i>	<i>More positive perceptions of success in team performance will generate higher levels of team click.</i>
<i>H1b</i>	<i>Higher levels of team click will lead to higher levels of social bonding.</i>
Secondary Hypothesis (H2): Better-than-expected execution of joint action will mediate a relationship between prior levels of uncertainty and team click. Specifically:	
<i>H2a</i>	<i>Higher levels of uncertainty in joint action lead to lower expectations of successful team performance.</i>
<i>H2b</i>	<i>More positive perceptions of team performance relative to prior expectations will lead to higher levels of team click.</i>

3

Research Setting

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3.1 The Temple of the God of Agriculture Sports Institute

On my first visit to the Institute, I entered via the main entrance in the south (see Figure 3.1). I made my way west to the administration building by hugging the southwest perimeter of the 30,000 seat capacity, multi-purpose sport stadium that dominates the Institute’s campus. My aim that Monday morning was to confirm the details of my proposed research with the vice principal of the Institute, as

well as the head coach of the rugby program.

I knew both the vice principal and the head coach from time spent in China studying (2006 and 2008) and coaching rugby (2013) prior to my doctoral research. Although I had already received positive responses from both during the planning stages of my research, I still needed to confirm arrangements for research face-to-face.

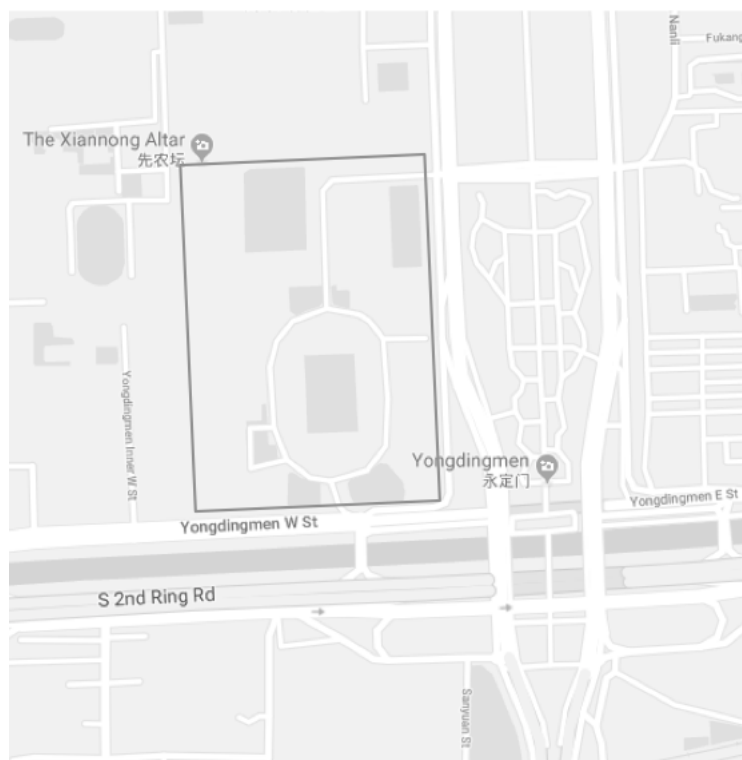


Figure 3.1: Location of the Temple of the God of Agriculture Sports Technology Institute (Source: Google Maps).

When I announced to friends within the Chinese rugby community in Beijing that I was preparing to conduct research with the Beijing rugby team at the Institute, I received mixed reactions. Those reasonably well acquainted with the politics of rugby in Beijing, rugby in China, or sport in China more generally, warned me about becoming too involved. Adrian, for example, warned me to be careful, citing that the Institute was riddled with ghosts: “There really are ghosts there, I’m telling you Lijie, you should keep your distance” (真的有鬼啊，我告诉你李杰，你最好离远点吧).¹ I naturally scoffed at these warnings, which were

¹Lijie (李杰) is my Chinese name.

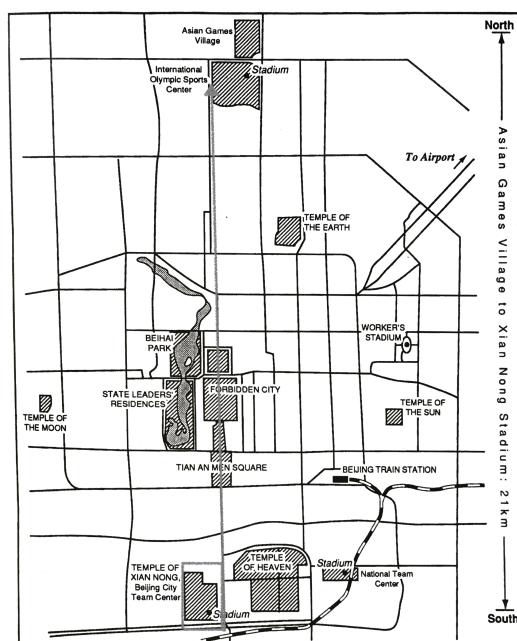


Figure 3.2: Locations of former Qing dynasty temples and modern sport stadiums along Beijing's sacred north-south axis (Brownell, 2008).

admittedly tongue-in-cheek. I was, however, intrigued to learn more about the cultural, political, and psychological—as well as ancient cosmological—principles that lay beneath the recent history of the Institute.

The Institute is located in the heart of Beijing, just to the west of Yongding gate on the South 2nd Ring Road. As one can imagine, given Beijing's 3000-year history, the centrally located land on which the Institute sits was not always home to sport facilities and professional athletes. The Institute takes its name from the temple that was built on the land during the Ming Dynasty in the 15th century. Yongding gate marks the southern end of the city's ancient north-south axis, which also includes, from south to north: Tiananmen Square, the Forbidden City, Jingshan Park, and the Drum and Bell Towers (see Figure 3.2). For thousands of years, Chinese cities have been laid out on a north-south axis according to the principles of feng shui. The auspicious power or energy (*qi* 气) of each monument along this axis is believed to flow upward from the south (south being the most auspicious and therefore important of the Four Directions in Chinese cosmology).

In addition to this spatial dimension of cosmological order, dynastic powers also

sought to reinforce order temporally, through regular performances of ceremonial sacrifices. In the Ming and Qing Dynasties, Emperors (or their commissioned representatives) used the Temple of the God of Agriculture during the middle month of Autumn and Spring (according to the Chinese lunar calendar), to perform Middle Sacrifices (in a system of Grand, Middle, and Common sacrifices) in honour of the Harvest (*nong* 农)—one of the four main cosmological principles, in addition to Heaven (*tian* 天), Earth (*di* 地), and Ancestors (*zu* 祖; see Brownell, 2008, p. 98). However, when the Qing Dynasty (1644—1912) finally buckled under the pressure of Western Imperial occupation and popular revolutionary political movements in 1912, Confucian Sacrifices in Beijing's various temples ceased.

But as one form of ritual expired in China, another form began. The embrace of the practise and spectacle of modern sport by the Republic of China (ROC, 1912—1948) and the People's Republic of China (PRC, 1949—present) has been so resounding and fundamental that sport stadiums (and the sporting events for which these stadiums were specifically constructed) have supplanted ancient temples and rites along Beijing's sacred north-south axis as a medium of communicating state order (Brownell, 1995). The flow of auspicious cosmological energy in Beijing now begins with the Institute (which was originally founded in 1930) in the south, and ends 21km to the north where the National Stadium, National Aquatic Centre, and the Olympic Green—the iconic monuments of the Beijing 2008 Summer Olympics—are situated. Since re-joining the International Olympic Committee in 1979, China's athletes have participated at every Summer and Winter Olympics (except for the 1980 Moscow Summer Olympics, for which China joined 65 other nations in boycott following the Soviet Union's invasion of Afghanistan in 1979), winning over 600 medals in 28 different sports. China's performance on the international stage has been facilitated by a now enormous state-sponsored competitive sport system (*jingji tiyu tizhi* 竞技体育体制), which consists of thousands of sport programs housed in secondary and tertiary level education institutions and specialist sport institutes throughout China's 34 provincial level prefectures. According to China's National Bureau of Statistics, in 2016 China's sport industry reached a total scale of RMB

1.9 trillion (USD300 billion). Since 2014, when the central government first declared plans for sport to become a “pillar industry” of China’s modern economy, the sport industry has been growing by an average of 18.2% per year. The central government has set a target total scale of 5 trillion yuan (USD800 billion) or 2% of GDP by 2025.²

The Temple of the God of Agriculture first became associated with sport in the form of a horse-racing track at the southern gate of the Temple at the end of the Qing dynasty. Even in this period of history, not all of the energy that flowed from the sacred temple has been auspicious. As I will explain below, the arrival of rugby to the Institute has been a predominant source of much of the most recent political and cosmological turbulence. In brief, I entered the Institute almost two years after its rugby program had experienced a dramatic fall from grace following a publicly humiliating controversy that unfolded at the National Games in 2013.

Although I was personally captivated by the fact that the Institute was located in such a culturally meaningful location in Beijing, I was also slightly apprehensive about the state in which I would find the rugby program and the Institute.

It was with a slight pang of nervousness, therefore, that I entered the Institute wanting to know more about how athletes experienced joint action *in situ*. I made my way from the southern gate, around the stadium, and towards the main office building to meet the Institute’s vice principal.

3.2 Cultural affordances of rugby in China

In the previous chapter, I explained that a general account of team click in group exercise is underwritten by a relationship between uncertainty and coordination in joint action. Higher levels of uncertainty in joint action—found, invariably, in group exercise contexts—will demand higher levels of coordination in order for team performance to be performed successfully. In this hypothesised relationship, coordination of physical movement and social communication join forces to service

²For comparison, in 2016 the scale of the US sport industry was USD400 billion. At present, the Chinese sport industry is dominated by manufacturing (sport equipment, apparel, etc). There is therefore considerable room in the Chinese sport sector for much higher value inputs, such as the development of the sports services (tournaments, leagues, activities).

an overarching mandate to uncertainty reduction (Friston & Frith, 2015a; Clark, 2015a). In joint action settings involving higher levels of uncertainty, higher levels of coordination will generate visceral and socially agentic experiences characteristic of team click, and, in turn, social bonding.

How can we begin to identify evidence for a relationship between uncertainty and coordination in real-world group exercise settings? Here, I consider this question in relationship to the research setting of rugby in China. It may indeed prove difficult for an anthropologist to directly measure the dynamical quantities of uncertainty and coordination in joint action *in situ*. Instead, I suggest that it is possible to infer the operation of both quantities through analysis of patterns of observable experience of joint action. In particular, I suggest that the concept of “cultural affordances” can aide this inferential process. As discussed in the previous Chapter, cultural affordances are a foundational tenet of the AIF (see Chapter 2.4.2). Cultural affordances can be defined as sociocultural scaffoldings that reliably shape patterns of perception and experience in joint action (Ramstead et al., 2016). In other words, cultural affordances are the shared resources of an environment that enable and constrain individual attempts to reduce uncertainty in joint action (Friston et al., 2012). I propose that an in-depth ethnographic analysis of the cultural affordances relevant to rugby in China will render visible the more discrete processes pertaining to joint action, team click, and social bonding hypothesised to operate in joint action settings.

Thus, in this chapter, I introduce three layers of context in order to situate a general theory of team click in the context of rugby in China. The first layer is rugby union—specifically, the parameters of joint action that rugby union prescribes. The second layer is contemporary China—in particular, a dominant relational mode of social cognition that reliably shapes patterns of attention, social interaction, and institutional life. The third layer is the particular history of rugby in China, which affords athletes the opportunity to pursue strategic life-course opportunities relating to education and future employment through adherence to the sport. Each of these layers contain assemblages of cultural affordances that serve to motivate, shape, and

constrain patterns of uncertainty and coordination in joint action. By analysing the ways in which athletes in China interact with these three layers of context, the contours of a relationship between uncertainty and coordination in joint action can then be identified more distinctly (see Chapter 4). In turn, hypotheses relating to team click in group exercise can be assessed (see Chapter 5).

To re-emphasise my aim: in this thesis, I do not attempt to explicitly address the question of how variation according to activity or culture alters hypothesised relationships between joint action, team click, and social bonding. Rather, I seek to situate general theoretical claims within a specific group exercise setting, so that these claims can be meaningfully tested. But, before progressing straight to an assessment of the research hypotheses of this thesis in light of empirical ethnographic data, it is crucial to first comprehend the nature of affordances that reliably shape athlete experience and expression of joint action.

Rugby union is an interactive, field-based team sport that requires of its participants high levels of uncertainty owing to complex, socially coordinated movement and extreme levels of physiological exertion. In addition, rugby is anecdotally and colloquially associated with social bonding in many of the contexts in which it is commonly played (Dunning & Sheard, 2005). The combination of highly complex and physiologically costly joint action demands, and anecdotally observable social effects, makes rugby union an ideal arena to investigate the predicted explanatory role of team click in a theory of social bonding through joint action (H1).

Studying the sport of rugby in a non-traditional rugby playing nation like China creates a unique opportunity to assess the hypothesised role of uncertainty in joint action on team click and social bonding (H2). High levels of natural variation in familiarity with the technical requirements of rugby union, particularly among the members of the Beijing men's team, meant that I was able to investigate the role of varying levels of uncertainty on experiences of joint action, including perceptions of team performance, team click, and social bonding.

Through the course of my ethnographic research, I also discovered that cultural processes generalisable to contemporary China featured prominently in athlete experience of joint action. Numerous strands of psychological and anthropological research have converged on the proposal that cultural systems can shape patterns of attention and behaviour in non-negligible ways. With the longest continuous cultural history in the world, China boasts a rich and diverse terrain of cultural affordances that are of potential relevance to culturally specific patterns of experience in joint action. Of most relevance to this thesis is the proposal that the cultural context of contemporary China (broadly construed) facilitates a *relational* mode of social cognition (Nisbett, 2003; Yuki, Maddux, Brewer, & Takemura, 2005). As I outline in more detail below, a mode of social cognition refers to the way in which a specific field of cultural affordances reliably shape patterns of action and perception, self-construal, group formation, and institutional norms (Nisbett & Masuda, 2003). As I demonstrate in relation to my research with the Beijing men's rugby team, I found evidence that a relational mode of social cognition constantly featured in athlete perceptions of joint action, expressions of group membership to the team, as well as to engagement with broader socio-institutional processes in which they were embedded (Chapter 4).

Rugby in China occupies a unique position in the Chinese state sport system, which affords to its adherents attractive life-course opportunities. By virtue of its Olympic status, rugby is a member of a competitive sports system in which provinces compete quadrennially for the coveted prize of National Games champion. Due to iterations of sport policy in China since 1976, almost all professional sport institutes in China are somehow tethered to tertiary education institutions. Thus, minnow sports in China such as rugby offer an attractive opportunity for athletes to access education and future employment opportunities associated with being a professional athlete. It often appears, on the face of things, that athletes' primary motivation for adherence to rugby is to pursue individual-level strategic goals of life-course advancement. The prominence of these motivations raises interesting questions for collective performance in team sport. If athletes come to the Institute

in Beijing primarily to pursue strategic life-course opportunities, then what does this mean for processes of team click and social bonding?

In the chapters that follow, I develop a response to this question, based primarily on ethnographic research with the Beijing mens' rugby team. I suggest that athlete experience of joint action is not shaped by one primary motivation, mode of social cognition, or parameter of on-field joint action. Rather, the layers of context sketched above (and introduced in more detail below) interact to afford patterns of on- and off-field coordination. In essence, I suggest that the potential for team click and social bonding exists despite competition between affordances for joint action.

In the sections that follow, I situate a general account of team click in group exercise by introducing the cultural affordances that will reliably shape and pattern athlete experiences of joint action. I introduce the cultural affordances associated with rugby, contemporary China, and the specific trajectory of rugby in China.

3.3 Uncertainty and coordination in rugby

Joint action in rugby is defined by high levels of uncertainty and, relatedly, high levels of coordination of on-field movement and off-field social communication between co-actors. Thus, rugby offers a suitable real-world context in which to investigate and assess a general account of team click in group exercise. In this section, I review existing evidence for uncertainty and physical and social coordination in rugby.

3.3.0.1 Uncertainty

The diversity of technical demands in joint action make rugby a highly uncertain group exercise setting. Rugby's joint action demands a diverse and varied set of technical skills (involving numerous co-actors, sensory modalities, and spatio-temporal scales) to be executed on-line and in the moment. Rugby players run with the ball, pass or kick the ball to other attackers or towards open space on the field, enter collisions as either ball-carrier, tackler, or support player, and contest possession of the ball by grappling in "rucks" and "mauls" (Ross, Gill, & Cronin,

2015).³ Like many equivalent team sports in which a single ball (or similar object) is contested, such as basketball, association football, and ice hockey, game play in rugby typically involves a series of sub-phases in which attacking and defending subunits of athletes contest possession of the ball (Passos et al., 2011). Athletes commit to multiple hierarchically nested goals—some of which they share with the entire field of athletes (for example, the shared goal of playing a game, or adhering to the rules of rugby), while other goals they share only with their own teammates (e.g., winning the game, controlling possession of the ball), or with a select subset of their teammates (e.g., coordinating with a teammate in attack to outsmart the defence). In addition, competition between teams in rugby will further increase uncertainty, owing to the continual presence of attempts to foil and disrupt prediction, perception, and action. It is also possible that extremely high levels of physiological exertion characteristic of rugby could have indirect implications for cognitive function (Dietrich, 2004b).

All of these factors, considered together, suggest that rugby’s joint action will be experienced as highly uncertain. It can therefore be expected that athletes who play rugby—particularly for individuals or teams whose familiarity with rugby is relatively low—will experience the game as challenging owing to high levels of cognitive uncertainty.

For rugby players in China in particular, it is even more likely that high levels of uncertainty in joint action will pose high technical challenges, owing to the sport’s minnow status within the Chinese sports system (explained in Section 3.4.2). Most professional rugby players in China either start from scratch with sport when they arrive at rugby programs as young adults, or else transition to rugby from an individual sport (such as athletics) defined by lower levels of joint action uncertainty.

3.3.1 Coordination

In line with the predictions of the AIF outlined in the previous chapter, it can be expected that higher levels of uncertainty in rugby’s joint action will demand

³In distinction to American Football (NFL), in rugby only the defensive team is permitted to tackle the the ball-carrier from the attacking team.

higher levels of coordination of physical movement and social communication in order for players to perceive their action as more successful. Existing evidence surrounding the sport of rugby supports this suggestion: rugby's on-field demands clearly require high levels of coordination in order for joint action to be performed successfully. There is also existing evidence to suggest that rugby is associated with processes characteristic of social bonding.

3.3.1.1 Physical coordination

In the case of rugby, all action is joint action. The performance of almost all technical actions require either direct or indirect consideration of the position and intentions of other athletes in relation to that action (Downey, 2012). Even the most seemingly independent technical operation among these skills—for example, an athlete kicking the rugby ball to open space on the field—requires the consideration of positioning of other athletes. Joint action in rugby is therefore defined by high levels of on-field interdependence.

Because all action is joint action in rugby, it is hard to delineate perceptions of joint action from individual action. Instead, I characterise joint action in terms of individual-level and team-level perceptions of performance. Perceptions of team performance may include the development of an impression of how the team (or a specific subunit of the team) is managing to coordinate the defensive or attacking line, or how well the team is communicating throughout a game, or supporting each other in attack and defence. Perceptions of individual performance, by contrast, may involve athlete perceptions of their individual-level contributions to attack, such as the quality of their passing technique, or their positioning as ball-receiver, or their ability to make effective decisions. In defence, athletes may attend to individual level performance such as one-on-one tackling performance, or effectiveness in contesting possession in rucks or mauls (effectiveness in the “contact” area). In this sense, one level of performance evaluation is more dominantly team-based, while the other is more dominantly individually-based. Given that team click is an inherently

team-level perception (see Chapter 2.3), I focus predominantly on perceptions of team performance success as a predictor of team click and social bonding.

Recent research has demonstrated the existence of functional interpersonal synergies existing between co-actors in rugby. Cognitive scientist Pedro Passos and colleagues have demonstrated that rugby players functionally regulate interpersonal distance between self and others based on the affordances of the task-specific environment (e.g., the location of other athletes, and the space available on the field, see: Passos et al., 2011), as well as dynamical properties of group-level interactions (Passos et al., 2014). These results suggest that FIS can be a viable solution to the uncertainty of joint action in rugby. Based on suggestions made in Chapter 2.4.3, it can be expected that higher levels of coordination of physical movement will set the foundation for higher levels of social coordination.

3.3.1.2 Social coordination

Rugby also appears to generate experiences and perceptions characteristic of social bonding. Rugby is a sport traditionally associated with the colloquial interpretation of “social bonding,” particularly in all-male social organisation common in the elite educational spaces of England and Commonwealth countries in which rugby originally developed (Dunning & Sheard, 2005; Richards, 2007; Collins, 2008).⁴ Rugby is also a sport associated with social virtues. “Rugby is a game for barbarians played by gentlemen,” or so the saying goes.⁵ Different inflections on this adage have been reproduced by people in all parts of the world that rugby has reached, including China (see Taylor, 2010). Presumably, this saying has survived due to its ability to tether the nature of rugby’s physical requirements with socially valorised

⁴Recently, rugby union has been the site of much criticism due to the fact all-male social groups that cohere around the sport of rugby appear to support and sustain hyper-masculine and hyper-normative behaviours, including gender-related violence (Cosslett, 2014).

⁵The origins of this oft-cited adage are unclear. The phrase is supposedly the adopted motto of the British Barbarians Football Club, established in 1890 (Dunning & Sheard, 2005, p. 34). The complete phrase reads “Rugby is a game for barbarians played by gentlemen, football is a game for gentlemen played by barbarians.” However, official club history cites its original motto as, ‘Rugby Football is a game for gentlemen in all classes, but for no bad sportsman in any class’ (Starmer-Smith, 1977, p. vii). Some sources attribute the saying to British writer and poet Oscar Wilde (1854-1900) (David, 2015).

moral virtues of fair play, cooperation, and integrity. The current slogan of World Rugby (rugby's international governing body) is "Building character since 1886," (WorldRugby, 2017). This phrase was presumably chosen to draw an association between the joint action requirements of rugby and the moral and social character that can be generated through participation in rugby.

In sum, rugby will be highly suited to application of a general account of team click in joint exercise, due to the way in which the rugby appears to reliably generate uncertainty and demand physical and social coordination in joint action. As predicted by the AIF, higher levels of uncertainty in joint action will demand high levels of coordination of physical movement and social communication for joint action to be successful. This proposal serves as a foundation for the core hypothesis of this thesis (H1), which states that higher levels of perceived success in joint action will predict higher levels of social bonding, mediated by team click. In addition, high levels of uncertainty in rugby's joint action will allow for the assessment of the second hypothesis of this thesis (H2), which states that higher levels of team click will arise from a pathway involving two causal relationships: one between higher levels of uncertainty in joint action and lower levels of expectations surrounding team performance success (H2a), and higher levels of positive expectation violation and team click (H2b).

Based on these considerations of rugby's physical and social joint action requirements, it can be expected that rugby's joint action, and team performance in particular, will entail high levels of uncertainty, and demand high levels of physical and social coordination in order for team performance in joint action to be successful. Under these conditions, I expect that athletes will experience uncertainty in rugby's joint action as a technical challenge that leads to social inferences. Such inferences could include 1) low expectations for team performance (relative to individual performance), 2) stress and or anxiety concerning (pre performance or when performance fails), or 3) elation or positive affect (when joint action is successful). Coordination of physical movement and social communication should be identifiable in terms of experiences of interdependence on and off the field.

3.3.2 Contemporary China

In this section, I introduce tenets of a Chinese relational mode of social cognition, which evidence suggests will reliably shape and pattern experiences of joint action in contemporary China. Specifically, a) relational processes of holistic reasoning about social relationships and dynamics; b) attention to particularistic, hierarchical networks of social relationships; and c) the social virtue of personal cultivation will bear upon coordination of on- and off-field physical movement and social communication in group exercise contexts in contemporary China. Comprehending variation in modes of social cognition according to culture is an important prerequisite for situating a general account of team click in a real-world group exercise setting. Recognition of variation in processes of social cognition allows for the accurate identification and interpretation of primary data, in this case pertaining to the experience of team click and social bonding in joint action.

A gradual accumulation of research across the human sciences suggests that cultural environments can reliably shape attention, perception, and action. Anthropologists have for some time emphasised meaningful cultural variation in processes of social group formation (Strodtbeck & Hook, 1961; Kluckhohn & Strodtbeck, 1961; Mead, 1967; Fei, 1992), and cultural psychologists have sought to demonstrate this variation in experimental paradigms (Markus & Kitayama, 1991; Nisbett, Peng, Choi, & Norenzayan, 2001). More recently, various strands of “indigenous” psychology (e.g., Chinese indigenous psychology, see Liu, Li, & Yue, 2009), have sought to compliment cultural psychology—which largely seeks to test variation in psychological processes between different cultural systems—by attempting to account also for variation within cultures. Together, this research offers a framework that allows for a scientific description of the various cultural affordances that may reliably shape and pattern experiences of joint action in contemporary China.

A core finding from cross-cultural psychology concerns the correlation between cultural variation and modes of group formation. Current research suggests a theoretical spectrum of processes of group membership, the two poles of which are usually described as “categorical” and “relational” (Hofstede, 1980; Brewer &

Chen, 2007). In the case of some cultural niches, traditionally samples from modern and industrialised “Western” societies (such as the USA), social group identity formation revolves around the autonomy and immutability of social categories of “self” and “group.” By contrast, in societies in which a “relational” mode is dominant (for example, in East Asian countries such as Japan, China, Korea, etc.), group identity is defined primarily according to degrees of social embeddedness and interdependence with others comprising their in-groups (Leung & Au, 2012).

A considerable amount of evidence has amassed within cultural and social psychology to suggest that the existence of meaningful contrasts between samples of East Asian populations (predominantly undergraduate students of Japanese, Chinese, and South Korean universities) and Western populations (predominantly undergraduate students of North American and Western European universities) in domains of attention and perception (Peng et al., 1997; Nisbett, 2003), psychological construal of social categories of self and group (Markus & Kitayama, 1991), behavioural tendencies in social interaction (Yuki, 2003), and institutional norms (Liu, 2017). Modes of group membership have been shown to vary not only across cultures (i.e., East Asian versus Western European or North American), but also within cultures (Henrich, 2014), within social groups (according to sex and personality differences, see Yuki & Takemura, 2014), and even within individuals (depending on contextual and situational primes, see Lee & Jeyaraj, 2014; Wong & Hong, 2005). The prominence of one mode of membership over another in broad ethnic or cultural groups (e.g., The West versus East Asia) appears to be associated with the durable persistence of cultural and linguistic institutions that afford particular patterns of social cognition. Thus, while broad cultural modes of social cognition are not understood to be hard-wired, it can be expected that distinct cultural trajectories will enable the production and transmission of reliable patterns of social cognition over others (Claidière, Scott-Phillips, & Sperber, 2014; Mesoudi, Chang, Murray, & Lu, 2015).

Divergent modes of social cognition appear to reliably preference different psychological mechanisms for processes of group membership and social self-construal.

The canonical “social identification” paradigm of social psychology, for example, requires that an individual make an identification between abstract categories of the self and the in-group or out-group (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). Group membership is achieved when the perceived differences between the self and other in-group members are smaller than the perceived differences between in-group and out-group members (Yuki & Takemura, 2014). Categories of self, other, and group are rendered as material entities that reliably moor an individual’s perception of personal and social identity. This proposal forms the basis of many validated psychological constructs used by social and evolutionary psychologists to measure social bonding and affiliation between individuals and between individuals and the group (Swann et al., 2009; Wolf et al., 2016). Thus, there is a general persuasion in social and evolutionary psychology to conceive of (and measure) social processes of group membership in terms of categorical social identity (Liu, 2015).

In distinction to categorical modes of social cognition, relational modes of social cognition predict that individuals attend more predominantly to maintaining and harmonising intra-group relationships, rather than engaging in intergroup categorical comparisons to substantiate individual psychological reality (Yuki, 2003). In a relational mode of group membership, social identity derives less from a calculation of psychological distance between abstract categories of self and in-group, and more from a degree of commitment to cultivating a network of hierarchically structured—but more or less self-centred and self-enhancing—relationships (Liu et al., 2009; Nisbett, 2003).

It has been shown experimentally that categorical group processes facilitate fast and effective identification with arbitrary minimal groups (Diehl, 1990; Van Bavel, LM, & Xiao, 2014), arousal of intrapersonal cognitive dissonance between the self and experimentally constructed in-group (Festinger, 1957; Stone & Cooper, 2001), higher levels of cooperation with categorically similar strangers in economic games (Yuki et al., 2005; Yuki, 2003), and greater attention and memory recall (Buchan, Johnson, & Croson, 2006; Ng, Steele, & Sasaki, 2016). By contrast, the inverse is usually observed in experiments where relational processes of group

membership are made more prominent or salient. It has been noted, for instance, that minimal group experimental paradigms have had very little (if any) success in East Asian (particularly Japanese) contexts (Liu et al., 2009, p. 586). Instead, relational group processes appear to allow for the arousal of cognitive dissonance only when it is constructed interpersonally (as opposed to intra-personally) between an individual and specific individuals to which that individual is connected by a meaningful social relationship (Hoshino-Browne et al., 2005). Likewise, individuals with predominantly relational group awareness are more willing to cooperate with and attend to strangers with whom they share relational rather than categorical ties (Ng et al., 2016; Yuki et al., 2005).

Understanding the cultural contours of social cognition in China requires an engagement not only with contemporary findings from cultural social psychology of group membership, but also with what social psychologist James Liu terms an “indigenous Chinese psychology” (Triandis, 1996; Liu et al., 2009). Liu argues that theoretical generalisations based on evidence from cultural psychology alone run the risk of being frail to the behavioural diversity observable both between the East Asian nations (Japan, China, Korea among others), and within each individual nation itself (for example, the vast internal cultural variation in China between North and South, East and West; see Henrich, 2014). To bolster claims of cultural psychology, Liu and colleagues suggest the utilisation of a “representational” account of social psychology (Liu & Hilton, 2005), in which socially shared representations of history are central to creating, maintaining, and changing psychological identity and patterns of social interaction. A representational account accords neatly with the definition of cultural affordances adopted in this thesis.

Indigenous Chinese psychology locates tendencies for group membership within a specific historical trajectory of cultural processes. In particular, it is generally agreed that contemporary China is the product of an ongoing interaction between two distinguishable historical processes: 1) two millennia of cultural continuity associated with the ancient development of a singularly successful, multilingual Chinese civilisation, and 2) a more recent engagement with—including, importantly,

perceived sufferings and failings at the hands of, and hopes of rejuvenation within—global activities of commerce, governance, knowledge production, nation-building, and international relations (Liu et al., 2009). In turn, these processes have given rise to three core representational (i.e., cultural) affordances of indigenous Chinese psychology: 1) ethically-prescribed Confucianism, 2) formidable legal and bureaucratic systems of state governance, and 3) modern Chinese nationalism, fuelled by representations of Marxist/Leninist dialectical materialism and revolutionary spirit, as well as faith in scientific and technological advancement (Barmé, 2009).

Tenets of indigenous Chinese psychology can be combined with findings from cultural psychology to form three core processes of a distinctly Chinese relational mode of social cognition (Liu, 2014):

1. **Holistic reasoning** is commonly employed to represent and harmonise social relationships and avoid interpersonal conflict, via the principle of the “middle way” *zhongyong zhidao* 中庸之道).
2. **Hierarchical relationism** acts as a guide for managing hierarchically organised familial and social networks, known as “guanxi” (*guanxi* 关系).
3. **Personal cultivation** is employed as a means of accumulating ethical virtue, or “human heartedness” (*ren* 仁).

These three dimensions of Confucianism can be identified in cultural affordances that pervade all spaces of contemporary Chinese social life, and bear upon real-world processes of social interaction, including joint action typical of group exercise.

Holistic reasoning

The postulate of holistic reasoning is commonly employed to explain human social behaviour. Holistic reasoning involves less emphasis on reason in the Western epistemological sense (i.e., the search for ultimate knowledge via reduction), and instead suggests that manifest and latent aspects of reality come in and out of being through an interaction between the “Receptive” (*Yin* 阴) and “Creative” (*Yang*

阳) principles inherent in the universe (Leys, 1997). In the case of knowledge of social interaction, a dominant point of interest should not be unchanging human biology, but rather the dynamic and evolving patterns of family, groups, society, and culture (Nisbett, 2003).

Hierarchical relationism

Hierarchical relationism builds on the dialectical reasoning of holism to provide cues and directives for managing reciprocity and responsibility in particular kinship and extra-kin social relationships (*renqing* 人情: Maehr & Nicholls, 1980). In this system, the individual stands simultaneously in several different relationships with different people: as a junior in relation to parents and elders, and as a senior in relation to younger siblings, and students. While juniors are considered in Confucianism to owe their seniors reverence, seniors also have duties of benevolence and concern toward juniors. The Five Relationships are: 1) ruler to ruled, 2) father to son, 3) husband to wife, 4) elder brother to younger brother, and 5) friend to friend. Four of the five key relationships concern unequal hierarchical relationships, the only exception being friendship, in which reciprocity and respect is emphasised. Notably, none of the prescriptions concern strangers. Hierarchical relationism renders social interaction in a strong contrast to the practical ethics dominant in Western Europe and North America, which blends Enlightenment philosophy and Christian values to emphasise egalitarian concerns such “respect for thy neighbour” and Good Samaritanism (Liu & Hilton, 2005).

Personal cultivation

A common stereotype surrounding East Asian societies is that processes of group formation are highly “communal.” The emphasis within Confucianism of harmonising hierarchical relationships can easily lead to the assumption that, in East Asian societies, attention to the group takes precedence over attention to the individual self.

When explaining my research to interested non-expert observers, most would respond to my “elevator pitch” with generalisations about the communalism of Chinese society and how such factors would encourage higher levels of social bonding

in group exercise. This line of folk-reasoning, while potentially commensurate with some psychological and anthropological evidence deriving from modern Japan (Kitayama & Cohen, 2010), represents a common misconception of indigenous Chinese psychology that results from constructing a mutually exclusive individual-versus-group binary based on (Western) epistemological assumptions derived from categorical modes of social identification (Tu, 1998). In other words, to stereotype East Asian cultures as communal involves a categorical assumption: when individuals attend to the social category of the group, they do so at the expense of the category of the self.

In counter-distinction to this assumption, Confucian thought promotes cultivation of the personal self as central to accumulating social virtue (*ren* 仁), and vice-versa (Hwang, 2012). In this conception, acts of self-cultivation, rather than being interpreted as anti-social, are instead often celebrated as expressions of pro-sociality. This is supported by experimental evidence that personal-cultivation arouses little or no dissonance between categories of self and group (Suh, 2002), because these categories are generally understood to be distributed or porous rather than fixed and immutable (Nisbett, 2003). Thus, far from being a derogated act (as in the tall poppy syndrome common to cultural milieus such as Australia), in Confucianism, self-cultivation is understood as an appropriate and even ultimate path or “way” towards sagely transcendence (Hwang, 2012, p. 106), and has been valorised in styles of leadership and public conduct (Farh & Cheng, 2000; Cheng, Chou, Wu, Huang, & Farh, 2004).⁶ Thus, within a Chinese relational mode of social cognition, it can be expected that the self can serve as a useful vehicle for overt pro-social behaviour, without arousing conflict between others’ interests.

⁶Paternalistic leadership, defined as a “a style that combines strong discipline and authority with fatherly benevolence and moral integrity couched in a personalistic atmosphere” is an example of public conduct in which the self is promoted as a social vehicle (Cheng et al., 2004, p. 91). Paternalistic leadership promotes an ethic in which the individual acts in a dignified manner, exhibiting high self-confidence, tight control of information, and an unwillingness to delegate authority.

Implications of a Chinese relational mode of social cognition for joint action and group exercise

It can be expected that these three interrelated processes will be identifiable and salient in the context of rugby in China. Specifically, a Chinese relational mode of social cognition will entail holistic reasoning about, and hierarchical conceptions of social relationships and groups, and will tend to promote personal cultivation as an ethic of group membership. Importantly, relational and categorical processes should be understood as co-existing tendencies. In this sense, while social categories of team will be salient and functional in real-world instances of Chinese social cognition, it may be that a relational mode preferentially directs attention towards the cultivation of relationships as a social priority. In brief, I expect a relational mode of social cognition to be identifiable in patterns of attention, group membership, and institutional norms.

3.4 Research setting and method

In this section I provide an historical background to rugby in China and my ethnographic setting in particular. The history of professional rugby in China is situated within a specific history of modern sport in China. In brief, athletes who arrive at the Institute (and other institutions like it) are motivated primarily by the life-course opportunities that the rugby program at the Institute affords, namely tertiary education and future employment.

Rugby is an interactional team sport played on a rectangular field (100m x 70m), by two teams of 15 players each, who contest possession of an egg-shaped ball that can be used to score points (IRB, 2014). Descending from a variety of locally-specific folk games played in pre-industrial England, all loosely grouped as “football,” rugby developed within the elite public school system as a deliberate physical activity arbitrated by rules and regulations, before circulating through the arteries of Great Britain’s colonial empire as a leisurely pastime—a “sport” (Dunning & Sheard, 2005). In 1996, rugby became a professional sport and is played as such in Western Europe, the Southern hemisphere (Australia, New Zealand,

South Africa, and Argentina), and Japan. Rugby sevens—the specific focus of this thesis—is a modified version of the conventional 15-a-side game involving teams of 7-a-side, and 14-minute games played in a tournament structure over two or more days (rather than a one-off 80-minute match between two teams). Rugby sevens has grown in popularity more recently, particularly since its introduction to the Olympics for the 2016 Games in Rio de Janeiro. More so than the traditional version of the game, rugby sevens is played by countries all over the world, and attracts more balanced participation by men and women.

As I explain below, in China, rugby is a minnow team sport—a “cold gate” (*lengmen xiangmu* 冷门项目; a term that refers to a profession, trade, or branch of learning that receives little attention)—with very little public recognition. However, the recent inclusion of rugby in the Olympics (in its modified version of rugby sevens) means that there are now rugby programs throughout 10 of China’s 34 provincial-level prefectures. The integration in China between the state-sponsored competitive sport system and secondary and tertiary education systems means that rugby programs are attractive to athletes not usually because of the fame, fortune, or honour of city, provincial, or national-level representation that adherence to rugby could afford a professional rugby player elsewhere. Rather, athletes like Sun Hongwei arrive at the Institute motivated by the opportunity to attend a prestigious university, and thereafter to get a good job (see Chapter 2.1).

3.4.1 Sport in China

The emergence of modern sport and exercise in China is entangled with a history of interaction and conflict with, and embrace of foreign influence during the 19th, 20th, and 21st centuries. Prior to the introduction of Anglo-American interactional team sports and Northern European calisthenics (training exercises and gymnastics) in the late 19th century, physical activity that could be grouped in the broad category of sport and exercise was limited to a small collection of physical cultures indigenous to China, practices imported much earlier from south Asian religious traditions (e.g. Buddhism and Hinduism), and some activities imported from non-Han dynasties

such as Manchurian horse racing in the Qing dynasty. Historical records suggest that participation in almost all of these activities was limited to the imperial ruling classes and urban elites (Ge & Song, 2005).

Increased foreign imperial influence in China during the 19th century brought with it the introduction of an array of ideas and practices to China's urban elite ruling classes, including novel physical cultures of dress, adornment, leisure, and not least, physical exercise. Sport first manifested in China in the promotion of Anglo-American competitive sports by North American Christian missionary organisations such as the Young Men's Christian Association (YMCA), and the incorporation of Northern European calisthenics routines into military exercises (Morris, 2004, p. 240). Such techniques were soon popularised within elite intellectual communities as pedagogical tools designed to foster an explicit link between the strength of the physical body and the strength of the Chinese nation (Morris, 2004, p. 32; Brownell, 1995, p. 49).⁷

Tiyu (体育), the term in modern Chinese that most closely translates to sport, was one of many neologisms inherited from the Western social sciences via its Japanese translation (Morris, 1998). Importantly, *tiyu* encompasses more than just the modern Anglo-American competitive sports that the English word connotes (roughly translatable to *yundong* (运动)). The modern Chinese concept of sport refers to an entire culture and discipline of the body that is deeply intertwined with the political project of Chinese modernisation and advancement (Morris, 2004).⁸

During the Republican Era (1912-1949), sport in China began to develop among urban elite along two main strands—"competitive sports" (*jingji tiyu* 竞技体育) and "games and calisthenics" (*ticao* 体操). A significant aspect of competitive sports was the public spectacle of the "games meets" (*yundonghui* 运动会), in which the performance of emerging national and international political identities

⁷The belief that sport and exercise were important pedagogical tools in the development of physically and mentally strong subjects of modernisation—an idea increasingly popular at the time in Europe, North America, and Japan, (Elias & Dunning, 1986)—gelled with the values of a nationally (and internationally) motivated Chinese urban elite

⁸As Lydia Liu (1995: 58) points out, even the notion of "China" itself as a term linked to a national imaginary, only began to emerge as such through interaction with Western missionary discourses concerning "China" during the 2nd half of the 19th century.

could take place. As early as 1908, the Chinese sport community enshrined the Modern Olympic Games (*Aolinpike yundonghui* 奥林匹克运动会) as the pinnacle of participation in an international community of nations, and as such, the quadrennial global ritual has since preoccupied a collective Chinese sporting consciousness, and China's national consciousness more broadly (Jarvie, Hwang, & Brennan, 2008; Barmé, 2009; Brownell, 2008; Morris, 2004).

Along with many other facets of society after 1949 when the CCP took power, sport was institutionalised in line with Soviet bureaucratic models of governance. In 1952, the “State Sports (and Physical Culture) Commission” (*guojia tiyu yundon wiyuanhui* 国家体育运动委员会; hereafter the Sports Commission) was established, which acted as the central State organ responsible for the administration of “sport for the masses” (*qunzhong tiyu* 群众体育), “physical culture education” (*tiyujiayou* 体育教育), as well as an elite competitive sport infrastructure of institutes and training facilities (*jingji tiyu tixi* 竞技体育). The competitive sport system was designed with the intention of creating a fast track for the development of world class athletic talent, in lieu of a sports system as advanced as other (predominantly Western) nations, whose development pathways for athletes were more organically embedded within existing social and educational institutions (Brownell, 2008). By cultivating model athletes capable of performing and advocating the healthy, egalitarian, and militaristic body promoted by the CCP, competitive sport was designed to kick start more widespread engagement in “sport for the masses” and “sport education” (Brownell, 1995, p. 56).

Publicly, the proletarian body and the propagation of an ideology of active cultivation of the physical body was centralised in CCP propaganda (Brownell, 1995, p. 58). The body of the worker (*gongren* 工人), peasant (*nongren* 农), and soldier (*bingyuan* 兵员), as well as the body of the athlete (*yundongyuan* 运动员), were glorified for their “capacity for manual labour” (*laodongli* 劳动力)—the ideological foundation for the “proletarian revolution” (*wuchanjiuji dageming* 无产阶级革命) (Ge and G. 2005: 91). The “emancipation” (*fanshen* 翻身) and glorification of the physical, labouring body is particularly explicit in the propaganda posters of the

early Mao era (Ge & Song, 2005, p. 87) (see Figure 3.3). The athlete was thus positioned as a representative of Chinese nation building, and a dedicated sports system was erected to facilitate the fast-tracking of athletes to elite performance.

One of the symptoms of the inorganic erection of a sporting infrastructure was that elite sport institutes became separated from education institutions (Brownell, 2008). The widening gap between education and sport in China became the subject of public scrutiny in the early 1980s, but China's sporting success on an international stage during this period delayed any policy response. The PRC won a total of 32 medals at the 1984 Los Angeles Olympics—its first official appearance at the Olympics since it boycotted the games in 1952 due to a dispute with the Republic of China (now Chinese Taipei) over the use of “China.” Importantly, 15 of these 32 medals were gold, and this powerful display of strength on the international stage was an enormous moment for modern Chinese nationalism in the reform era (Brownell, 2008). When China produced a much less impressive performance in the summer Seoul Olympics in 1988, winning only 5 gold medals (and a total of 28), latent public criticism of way in which reform era sport had become isolated from society readily surfaced and a “crisis in Chinese sports” was declared (Brownell, 1995, p. 199). Amidst broader social anxieties concerning not only the alarming quantity of the Chinese population (*renkou guoduo* 人口过多), but also the problem of population *quality* (*renkou suzhi* 人口素质), the athlete in China was problematised as lacking sufficient “cultural quality” (*wenhua suzhi* 文化素质) in accordance with his or her elevated social status as a “representative” (*daibiao* 代表) of the Chinese nation on an ever-expanding international stage (General Administration of Sport 2009a; Brownell 1995: 95).

In response to this public crisis, in 1989 the Sports Commission adopted a policy modelled on the US college sports system, of “combining sport and education” (*tijiao jiehe* 体教结合). In an attempt to move away from a reliance on sport boarding schools and full-time sports training centres for the development of athletic talent, “high level sport programs” (*gaoji tiyu xiangmu* 高级体育项目) were embedded



Figure 3.3: Strengthen Physique to Defend Motherland (1950)

within existing stand-alone high schools and universities so as to ensure the “all-round development” (*quanmian fazhan* 全面发展) of the athlete (Brownell, 1995, p. 203). As part of an emphasis on a broader range of sports and their perceived potential to facilitate community engagement, international relations, as well as commercial opportunities, various sports programs, including many non-Olympic sports such as rugby (at the time), were inducted into the Chinese sports system for the first time (Knuttgen, 1990, p. 70). As I explain below, China’s first rugby program was a “high level sports program,” embedded at the Chinese Agricultural University in Beijing in 1990.

While China has experienced widespread social and economic transformation since the death of Mao in 1976, and while the sport system in particular has experienced numerous waves of policy reform, the core organisation and the logic of the Chinese sport systems remains largely in tact. Sports like football and basketball have matured as standalone enterprises with supporting market-based consumer industries. But most other sports in China (i.e., all other Olympic events, including rugby) exist primarily due to the support of the enormous state-sponsored sport system. Whereas the commercial basketball and football industries might offer a small percentage of prospective athletes incentives of fame and fortune, the benefits of a state-sponsored sports programs like rugby are more modest. Chinese youth either gravitate to or are ushered by their parents towards sporting careers primarily due to potential life-course opportunities such as access to tertiary education and post-athletic career employment.

Thus, the professional athlete in China occupies a unique position, as both a symbolic representative of Chinese nationalism, as well as the target of various incentives pertaining to life-course opportunities of education and employment. American cultural anthropologist Susan Brownell, in her monograph “Training the Body for China” (1995), was the first to provide a comprehensive development of the subjectivity of Chinese athletes in the (post-Mao) reform era in China. In reference to the unprecedented success of the Chinese women’s volleyball team in the 1980s, including winning China’s first ever gold medal in a team event at

the LA Olympics in 1984, Brownell explains how elite level sport functioned as a crucial symbolic practice for China in the process of re-joining the world (1995: 86). As a participant in the sports system as a student-athlete herself, Brownell draws on first-hand ethnographic experience of training and existing as subject to the state-administered “microtechniques of power” (citing Foucault, 1977) designed to cultivate athletes in post-Mao China. This unique empirical contribution serves to situate the athlete in China between tensions and shifts of an ever-transforming social terrain structured by contradictory forces of top-down state control and the emerging logic of the free market.

Despite valorisation of the athlete as part of the proletarian revolution during the Mao era, and some celebration of the nation’s top athletes during the post-Mao reform era, a career as a professional athlete remains far from highly desirable or coveted in China, at least not by urban elites. It is popularly understood that becoming an athlete in China entails sacrificing one’s youth (*qing chun* 青春); athletes train incredibly hard and are forced to endure bitterness (*chiku nailao* 吃苦耐勞). It is commonly understood that for women in particular, the physiological demands of being an athlete (weights training, training outside, or training during certain phases of menstrual cycle) can threaten one’s femininity and fertility, thus harming marriage prospects (Brownell, 1995). Although recent commercial growth of the sport industry in China has supported the rise and valorisation of “super star” athletes in Chinese sport, such as NBA athlete Yao Ming, or 110m hurdles Olympic Champion Liu Xiang, for most wealthy and educated urban Chinese families, the prospect of becoming an athlete does not compare to other life-course trajectories such as pursuing education. The history of separation between the competitive sport system and the education system is also a factor in discouraging Chinese youth and their families from pursuing sport if it threatens other more attractive life course possibilities within mainstream education institutions.

Since Brownell’s seminal work, very little research into the experience of athletes in China has been published (but see Brownell, 2000, 2008). In the more than 20 years since Brownell’s ethnographic work was conducted in China, processes of

expansion of the market-based economy and political reform have transformed the identity of the athlete in contemporary China, including the nature of incentives and choices available (Taylor, 2010). Yet, professional sport programs like the rugby program at the Institute, remain as attractive possibilities for the pursuit of life-course opportunities. Generally speaking, athletes rarely appear to gravitate to rugby programs in China looking for fame or fortune, or as part of a perceived duty to be a symbolic “representative” of the Chinese national cause.

3.4.2 Rugby in China

Although reportedly existing in China within colonial and expatriate circles for more than a century (Reason & James, 1979, p. 210), and as a modified military exercise as early as the 1930s (Morris, 2004, p. 135), rugby was a late entrant into the Chinese sport system, established as a “high-level sport program” at Chinese Agricultural University in 1990. The advent of rugby in China was thus part of the process of combining sport and education of Chinese sport initiated in the late 1980s.

The program was originally made up of existing CAU students who expressed interest in the novel activity, but by its second year, the program earned status as a high-level Sport Program and was subsequently advertised to student-athletes across the country (Xu, 2010, p. 2). Between 1990 and 2009, rugby programs based on this original CAU model were established within over 30 regular universities and specialist sports colleges in cities throughout China. In addition to these programs, a number of social rugby clubs (*shehui julebu* 社会俱乐部; organisations completely independent of the state sports system) began to form in major cities with high expat populations (e.g., Shanghai, Beijing, Chengdu, Qingdao).

For the first 20 years of its existence in China, Rugby was part of a large collection of “cold gate” sports in China, which had a relatively small participation base compared to other interactive team sports like basketball or football. The Chinese Rugby Football Association (CRFA) was established in 1997, and both the men and women’s national teams, made up of players predominantly from CAU, but also from other well-established programs based at the Shanghai Sports University,

Shenyang Sports College, and the People's Liberation Army Sports College. China consistently competes against other nations in the Asia Pacific region (most notably in the Asian Games and the East Asian Games), and is also occasionally involved in top-tier international tournaments such as the International Hong Kong Sevens.

Accrual of Olympic status in 2009 transformed rugby almost overnight from its former position as an amateur sport played at university level by a handful of universities. As an immediate consequence, in 2010 rugby (in its seven-a-side version of rugby sevens) was included as one of 33 events to be held at the 2013 National Games in the city of Shenyang. This decision spurred provinces to set up professional rugby programs at provincial sports institutes, to compete at the National Games in 2013. Ten of China's collection of 32 provinces and municipalities that participate in the National Games have full time men's and women's rugby programs. For Olympic sports in China, results in the National Games (*quanguo yundonghui* 全国运动会) decide the amount of funding a province and its constituent sporting institutes and programs receive. As such, the National Games are the most important measure of success for athletes, coaches, and administrators in the competitive sports system (Hong & Hua, 2002).

When rugby union was officially inducted into the state sponsored sports system in 2010, a total of five full time Men's (Beijing, Shandong, People's Liberation Army (PLA), Liaoning, and Shanghai) and six Women's (Beijing, Shandong, Anhui, Liaoning, Shanghai, and Jiangsu) provincial programs were immediately established, which signalled an intention by these provinces to invest in the sport for the long term. With the establishment of professional provincial rugby programs catering for tertiary aged athletes (17 years and above) already established, these provinces could subsequently initiate the establishment of city level rugby programs catering for high school aged athletes (10—16 years). In this way, a previously non-existent development pathway for athletes, coaches, and officials began to emerge in provinces interested in investing in the sport.

In addition to these full-time provincial programs, three part-time men's (Inner Mongolia, Heilongjiang, and Xinjiang) and two part-time women's (Sichuan

and Xingjiang) programs were established, in which these provinces temporarily employed rugby athletes from university programs. The special administrative region of Hong Kong also fielded both a Men's and a Women's side, bringing the total of Men's and Women's teams eligible to compete in the National Games to nine and ten, respectively.

3.4.2.1 The National Games 2013

Two provinces in particular identified an opportunity to achieve a favourable result at the National Games by heavily investing in this debutant sport in 2010. The Beijing men's and women's programs (based at the Institute) managed to attract a large amount of China's existing rugby talent from where it was previously based at the CAU. Importantly, among Beijing's recruits was the unofficially touted "Boss" (*Laoda* 老大) of Chinese rugby, Chinese national coach Zheng Hongjun. Meanwhile, Shandong province, a traditional powerhouse in other provincial sports, succeeded in attracting the majority of the remaining rugby talent. The pull to Shandong was strong for a large majority of rugby players in China at the time, many of which were originally from Shandong. Importantly, the talent transferred to Shandong province also included coaching staff, namely Zheng Hongjun's student and soon-to-be rival, former Chinese Women's Team coach, Lu Xiaohui. Besides Beijing and Shandong, Jiangsu and Anhui province were strong contenders for the Women's gold medal, while the People's Liberation Army (PLA) and Hong Kong in particular were strong contenders for top spot in the men's competition.

Beijing's results in the two years leading into the 2013 national games were strongest overall across the men's and women's teams. However, the traditionally strong Hong Kong men's and women's teams had only occasionally participated in these tournaments due to conflicting international tournaments. In the semi-finals of the National Games, held in Shenyang at the beginning of September 2013, the Beijing men came up against Hong Kong, while the Shandong men played off against the PLA. Beijing lost to their stronger and more favoured opponents, and Shandong beat the PLA. Meanwhile in the women's tournament, both Beijing

and Shandong advanced to the final without faltering. The stage was set: the traditional favourites, Beijing, led by the reigning Boss of Chinese rugby, would face Shandong—the underdogs—lead by the Boss’s cunning apprentice come challenger.

The men’s final was played first, and in somewhat of an upset, Shandong edged out Hong Kong to win the gold medal by one try (one five-point score or “touch down”). In the women’s final, scores were level until early in the 2nd half when Shandong went ahead by two tries to nil. At that point, the Beijing women’s team, allegedly under instruction from their coach Zheng Hongjun, suddenly stopped playing. After being asked by the referee and match officials to continue, the Beijing athletes stood firm and refused to play on, forming a huddle on their side of half-way in the middle of the field. Shandong had no choice but to continue to play out the rest of the 2nd half, running in try after try, until the final score at full time was a farcical 71-0 (Sina, 2013). Shandong was declared victorious, while Beijing called foul play, claiming that the Spanish referee had been unfairly adjudicating the match in Shandong’s favour. The details and dramas of this now well-known story in China’s sporting history, known as “The 2013 National Games Match Strike Scandal” (13年全运会巴塞门), require more extensive development in a format beyond the scope of this particular thesis. Suffice to say, the repercussions of this incident for the Beijing provincial rugby program were extremely costly.

3.4.3 The Temple of the God of Agriculture Sports Institute

The rugby match-striking-gate of 2013 led to a sudden fall from grace for the Beijing rugby programs. Between 2010 and 2013 (in the lead up to the the National Games), the Institute Leadership—excited about the prospect of unprecedented national-level success—immediately elevated the men’s and women’s rugby programs to top-priority status. Rugby received unrivalled institutional and financial support in the hope that both teams would be crowned National champions—what would have been the Institute’s first National Games gold medals since 2004. During this period, the rugby program attracted a high profile commercial sponsorship deal

from Beijing Capital Steel (北京首钢), which enabled the Institute to invest in a team of foreign coaches from New Zealand to come to Beijing on a periodic basis to consult on training and preparation. Both teams also travelled twice to New Zealand for two three-month stints of off-season training and competitions. Between 2010-2013, the rugby team lived in the Institute's best available accommodation, and ate their meals at the Institute's highest level canteen, reserved for National-level champions. Right up until the National Games in 2013, the men's and women's teams had met the high expectations set for them, winning all but one of seven national tournaments each. All indications were positive for Beijing to take home two gold medals. However, as explained above, the National Games in Shenyang in September 2013 did not transpire as Beijing would have hoped.

In the end, Beijing came away with one bronze medal (men's team) and one face-destroying disqualification for the women (official review of match referee performance found no evidence of clear foul adjudication). During my time at the Institute, assistant coach of the Beijing men's team, Shi Yan, told me quietly one evening that the Beijing women's rugby team was the first Beijing team in the 48-year history of the National Games not to receive the "medal for civilised spirit" (awarded by the Beijing Mayor to all Beijing representatives in the National Games). All rugby coaches and many senior athletes of the 2013 National Games campaign left the Institute immediately after the match-strike-gate, either to retirement or to continue playing at other provincial programs. The rugby program at the Institute was all but abandoned at the end of 2013, and remaining athletes from both men's and women's teams were told to take a break for an undetermined length of time.

Rugby at the Institute after 2013

It wasn't until April 2014, after the dust had settled on the embarrassment of the women's program's widely publicised disqualification, that the men's program was resurrected with the appointment of a new head coach. The women's program lay dormant for another full year until it was resurrected just in time for preparations for the 2017 National Games. Former Chinese rugby representative and CAU

coach Zhu Peihou was appointed as new head coach of the men's team. The junior athletes from the previous National Games cycle were recalled back to the Institute to resume training, and coach Zhu was charged with finding new talent to fill the ranks of the team.

The Beijing men's team endured a series of mediocre performances during the 2014 and 2015 seasons, and clearly lacked experience, talent, and support from the Institute. A handful of senior athletes who had played in the era of the 2013 National Games remained, and two in particular, Han Xiaolong and Lu Peng were promoted to a transitional athlete-coach status. Unlike Women's assistant coach and former athlete Wang Chongyi, however, both Han and Lu were originally from Shandong province and so did not automatically have Beijing residency required to make them eligible for full time employment at the Institute. As such, their future place at the Institute was uncertain, and as I found out from both during the course of my ethnographic research, their ability to stay at the Institute would depend on the result the team could achieve at the 2017 National Games: a medal at the National Games would qualify them for a fast-tracked and Institute-sponsored application for Beijing residency application.⁹

Despite being only a shell of its former glory, the rugby program at the Institute nonetheless offered attractive incentives to prospective athletes. The difficulties of Han and Lu in gaining Beijing residency made it clear to more junior athletes that there was little promise of a passage to official Beijing residency or full-time employment at the Institute. However, the program did offer a much more realistic opportunity of attending the Beijing Sports University (BSU)—considered to be the country's most prestigious sports university and one of China's select "big brand universities" (*mingpai daxue* 民牌大学). The mass exodus of experienced senior athletes from the rugby program meant that junior athletes from the pre-2013 era

⁹China's infamously rigid residency ("Hukou" 户口) system means that only individuals with Beijing residency can hold permanent employment roles at government institutions such as the Institute (*shiye danwei* 事业单位). Chinese citizens born outside of Beijing can become Beijing residents if offered employment, but due to Beijing's swelling population, the eligibility criteria for this process of naturalisation has become more and more stringent, and fewer and fewer applications are successfully processed, particularly in industries like sport.

were now in a position to represent Beijing at a national level, and in so doing attain the official athletic standard of a “Master Sportsperson” (*yundong jianjiang* 运动健将). A Master Sportsperson was automatically eligible to attend BSU through its arrangement with the Institute. It was in this context that I entered the Institute and began ethnographic research.

3.4.4 Method

The empirical research analysed in this thesis consists of an in-depth ethnographic study of the Beijing men’s rugby team ($n = 26$), and two field experimental studies: one survey study during a national rugby tournament ($n = 174$, *male* = 91), and a controlled field experiment ($n = 58$, *male* = 31). The methodological details of the field experimental studies are introduced in the introductory sections to each study (see Chapters 6 and 7). Below I outline the method through which I collected ethnographic data, with further detail included in Appendix C.

3.4.4.1 Ethnography

I conducted a three stretches of participant observation at the Institute, totalling ten months between September 2015 and September 2017 (1st stretch = 7 months, 2nd stretch = 2 months, 3rd stretch = 1 month). During these stretches, I lived full-time at the Institute and attended (and often participated in, predominantly as coach) training sessions, team meetings, meals, and any other activities relevant to the rugby program. In addition to participant observation, I also conducted semi-structured interviews and administered a series of informal surveys following training and at different intervals throughout my time at the Institute. I recorded field notes using Evernote (Version 7.4.1), an electronic note taking software that was synchronised across my mobile and personal computer devices.

The Institute was home to both a men’s and women’s rugby team, each with usually 20-30 athletes and 2-4 coaches per team. However, for reasons outlined above, when I arrived to conduct research only the men’s team was in active training. As such, I dedicated my ethnographic research to the Beijing men’s team only. I

analysed data on a total of 26 athletes ($M(\text{age}) = 20.96$, $\text{range} = 17-27$, $SD = 3.17$). Athletes were included in data analysis if they participated in 1) a semi-structured interview, 2) at least one informal survey relating to experiences of rugby training and group membership, and 3) at least two months of training at the Institute. I sought permission to conduct research at the Institute was from relevant authorities and directly from athletes at the beginning of the first research period in September 2015.

In addition to researching athletes, I also engaged coaches, officials, and informants with relevant knowledgeable of rugby and sport in China. Data collected on these individuals were not included in the main analysis, but provided valuable contextual information. All my interactions with athletes took place in Modern Standard Chinese (Mandarin or *putonghua* 普通话). To record these interactions, I would either interrupt conversation to ask permission to start the audio recording device within the Evernote application on my mobile phone. Alternatively, in the case of shorter or unplanned interactions that were relevant to my research questions, I transcribed these conversations using my notebook or phone immediately following their occurrence. Every week or fortnight I collated, summarised, and organised these notes by date and by theme. Interview recordings were transcribed into written Chinese by a native Chinese speaking research assistant using a “verbatim” method (i.e., including an account of all verbal and important nonverbal (coughs, pauses, etc.) utterances, see Poland, 2003, pp. 269-70). I analysed interviews in Chinese and only translated into English data extracts that were included in the main analysis of this thesis.

I collated all ethnographic data into a corpus that was subjected to a process of “thematic analysis” (Braun & Clarke, 2006). I identified themes that captured important information about the data in relation to a research question or hypothesis. I attempted to identify themes at both explicit and implicit levels of the data (Boyatzis, 1998).¹⁰ Following a process of theme rationalisation and reduction,

¹⁰The story of Sun Hongwei (see the opening vignette of Chapter 2.1) serves as a good example of the contrast between implicit and explicit levels of data. In our interview, Hongwei was able to articulate many conceptions relating to joint action and social bonding, all of which were recorded as explicit declarations. At the same time, I observed in training that Hongwei, while fluent in his declarations in interview, was far from fluent in his more embodied declarations on the field.

relevant data (selected from the original corpus) were reorganised in a matrix in which themes formed the columns, participants formed the rows, and selected evidence formed the cells (see Appendix C.2 for a full explanation of method).

The life of an athlete in the Beijing rugby team

The Beijing men's rugby team competed against other provinces in five national tournaments held in different locations across the country every year between March and September. The period in which I conducted my first stretch of ethnographic research (August 2015 — February 2016), therefore, constituted the off-season and pre-season components of the training year. Due to cold weather in the north of China during winter and spring, teams from northern China (e.g. Beijing, Liaoning, and Shandong provinces) often elected to train at other domestic or international training locations depending on amount of program funding available and the training strategy of each program. In 2015, before an unexpected change in coaching team at the end of December, the head coach of the Beijing Men's team had planned to travel to Yunnan province in early 2016 for one month of altitude training before moving closer to sea-level somewhere in the south of China for one month (February/March). Following the coaching leadership change, the team did not leave Beijing until after Chinese New Year (25th February). Training during this period was therefore consistently stationed at the Institute in Beijing, and as such subject to occasional disruption due to Beijing's cold winter weather and air pollution.

All athletes lived and trained 6 days a week at the Institute, and would occasionally attend university or high school classes as part of their ongoing education commitments. Below is a table of a typical weekly training schedule (see Figure 3.1). A typical week consisted of 10-two-and-a-half hour (≈ 150 minutes) training sessions, seven of which were on-field rugby sessions, three of which were strength and conditioning sessions (not involving rugby-specific skills). In addition, two one hour evening skills sessions were also allocated for junior athletes to hone their basic skills of passing, catching, and game-play. Athletes lived full-time on campus in

The combination of implicit and explicit data offered points of contrast and comparison that were fruitful for richer analysis.

Table 3.1: Typical weekly training schedule for the Beijing men's team.

Time	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
0600	Train		Train				
0900		Train	Train	Train	Train	Train	
1500	Train	Train		Train	Train		
1900		Train (junior)		Train (junior)			

the Institute's dormitory accommodation (usually 3 athletes per room), and were permitted to take overnight leave on the weekend after the conclusion of Saturday morning training. Athletes from Beijing or with family in Beijing would usually take this leave, while the remaining athletes would spend weekends at the Institute. Generally speaking, the rugby program would break at the end of the national season in September for two weeks, and occasionally around Chinese New Year for 7-10 days, unless New Year interrupts pre-season training plans, in which case training would continue in spite of this national holiday.

3.4.4.2 Positionality of the researcher

My unique positionality as a researcher requires further consideration, due to the way in which my identity as foreign “friend of Chinese rugby” (中国橄榄球的好朋友), professional athlete, and authoritative rugby coach may have induced bias in the testimonies and behaviours of my research participants (referred to in experimental psychology as “demand characteristics;” see McCambridge, de Bruin, & Witton, 2012).

My history of interaction with the Chinese rugby community (during previous stretches of study, work, and rugby coaching) meant that I was well known by most Chinese rugby coaches, and many current athletes, particularly older athletes. Of the 26 athletes whose data I analysed, I had only previously interacted with one athlete, Han Xiaolong (the most senior and experienced athlete in the team, Han was a student at CAU when I was based in Beijing in 2008). Indeed, my

established relationships and familiarity within the Chinese rugby community were what enabled unique access to group exercise context in the first place. However, my status as a well-known “friend of Chinese rugby” may have also left me liable to attracting from my participants testimonies and rationales that were in part motivated by their desire to tell me what they thought I wanted to hear (Clifford & Marcus, 1986). In addition, my position of authority in relation to rugby, owing to previous experience as a professional rugby player in Australia and my authority as occasional coach at the Institute, may have meant that athletes did not freely express their personal attitudes to me in interviews or in surveys.

Comparisons between China and the West commonly featured in my informal and semi-structured interactions with participants. By and large, athletes with whom I spoke understood that they were engaged in a fundamentally foreign or Western sport, and they would also often treat me—a foreigner with expert knowledge of rugby—as a representative of both the West and rugby in the West, more specifically. My specific research aims, questions, and hypotheses meant that I was not interested in disentangling the sources or meanings of these generalisations. Rather, I treated such rationales as evidence of the cultural affordances that athletes employed in order to successfully bridge the gap between our respective subjectivities.

In addition, while I consider myself professionally fluent in Modern Chinese, my level of proficiency was not at the level of a native speaker, and it is possible that at times I missed important nuance and detail that could have been relevant to interpretation of data. Further, my own intuitions and values may have influenced the ways in which I judged and inferred significance of certain observations and events over others.

Based on these considerations, I aimed to adopt a skeptical, self-reflexive stance when analysing ethnographic data (Lichterman, 2017), and attempted where possible to triangulate more explicit or declarative testimonies (e.g. interview data) with more implicit observational data (see, for example: Duffy, 1987). When briefing research participants, I explained that I was generally interested in researching “athletes’ on-field and off-field experience of rugby.” I hoped that by limiting

the detail associated with my brief, and by promoting the notion of (subjective) experience of adherence to rugby, I would encourage athletes to reflect in more personalised and less generalised or stereotypical ways.

3.5 Expectations for the field

In this chapter, I introduced three key layers of context that are important to understanding athletes' possible experience of uncertainty and coordination in rugby's joint action. In turn, a general account of team click in group exercise must be situated within these layers of context in order for it to be meaningfully tested. Due to the inherently high levels of uncertainty contained in rugby's joint action, I expect a link between uncertainty and coordination to be visible in rugby in China, albeit in forms that reflect culturally dominant modes of social attention, action, and group membership. In essence, while I expect athletes to arrive at the Institute motivated by strategic life-course opportunities, I also expect that rugby's joint action will reliably capture the attention of athletes and promote expressions of on-field and off-field coordination. In the following chapter, I present ethnographic evidence that confirms these expectations.

4

Uncertainty and coordination at the Institute

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4.1 The Captain's speech at a team banquet

The team dinner, organised at a restaurant adjacent to the Institute, was the first team ritual orchestrated by the new head coach Wang Chongyi. Following the abrupt departure of previous head coach Zhu, Wang told me he thought it was necessary to signal a new start for the team under his leadership as coach. So, one evening, he initiated a team banquet—a highly organised ceremony of eating, drinking, and speeches.

I arrived late to the dinner after all athletes had already sat down around a single large (but not quite large enough) banquet table in a private upstairs room at the restaurant. I immediately noticed that many of the junior athletes appeared nervous and up-tight. More than 20 athletes were crowded around the table, waiting for proceedings to begin.

Head coach Wang sat in the position opposite the entrance to the private dining room (the Chinese equivalent of the head of the table). Either side of Wang sat team captain-come-assistant coach Han Xiaolong and vice captain-come-assistant coach Lu Peng.¹ The remaining senior athletes sat either side of Han and Lu, in order of seniority, all the way until the opposite side of the table, where the most junior athletes were positioned.

Wang began the proceedings with three toasts (customary as the host), and then, from there, the senior athletes spoke in turn. After each toast, the entire team had to drink a portion of their rice wine (or beer, if or when the rice wine had been drunk). After the senior athletes had all had a chance to talk, the coaches directed small cohorts of more junior athletes to stand up and say a few sentences and then toast to the senior athletes and coaching staff.

The proceedings were relatively rigid to begin with, and from my position to the side of the table (I sat two places to the side of Han among the senior athletes), the scene resembled a rigid face-off between the senior athletes and coaches at one end of the table, and junior athletes on the other end. But, once the effects of the alcohol kicked in, social interaction began to flourish. Speeches became bold and fluid with both self-assertive pronouncements from senior athletes promising stronger and more resolute leadership, as well as self-critical admissions from more senior athletes. The spaces between formal toasts were filled with one-on-one sideline conversations between athletes and coaches in which junior and senior athletes intermingled.

Team captain Han Xiaolong's first speech, which came directly after Wang's three toasts, was one of the most bold and noteworthy in my eyes:

¹After Coach Zhu Peihou left the Institute, Han and Lu were promoted to assistant coaches.

I don't know if all of you have your own personal goal? I at least know that I have a goal, and that is to win next year's National Games gold medal. That is what motivates me; that is what I am sacrificing for. I don't know exactly what your goals are, but if you don't have a goal then your (personal) goal should be to help me achieve my goal. I toast to everyone helping me achieve my dream [of winning a National Games gold medal]!

我不知道你们都有自己的目标吗？我至少知道我有一个目标，那就是拿到明年全运会的金牌。这就是我的动力，就是我所牺牲的。我不确定你的目标是什么，但如果你没有目标，那你的目标应该是帮助我实现我的目标。我向所有人致敬，帮助我实现自己的梦想！

I was automatically struck by these remarks. Upon reflection, I suspected that the intuitions for team membership that I had developed in rugby contexts elsewhere prepared me for a speech in which Han would seek to embody an egalitarian notion of group membership. Han was the most senior athlete in the team, he was the former team captain and was now in transition to coach. “We are all equal under the category of the team,” he ought to say; we are all in this together (aren't we)? Instead, in his prime-time team captain talk, Han was intuitively compelled to demonstrate the strength of his own personal conviction as a means to foster team solidarity within a explicitly hierarchical social order.

4.2 Situating team click in rugby in China

During my time at the Institute, I experienced many examples in which what I observed on and off the rugby field chafed against my personal intuitions concerning rugby and team membership. Over time, I realised that this tension was a productive one, and it encouraged me to interrogate more deeply the role of cultural affordances in shaping patterns of experience and expression of joint action.

In this chapter, I present ethnographic evidence that serves to situate a general account of team click in group exercise in the context of professional rugby in China. In particular, I investigate the way in which athletes of the Beijing men's rugby team experience uncertainty in joint action, and the extent to which uncertainty can be associated with physical and social coordination. This chapter sets an

empirical foundation for a focussed analysis of experiences of team click and joint action (see Chapter 5).

Ethnographic evidence suggests that athletes' general unfamiliarity with rugby prior to arriving at the Institute, and high variation in athlete technical competence within the team, will mean that rugby's joint action may be experienced as challenging, owing to its high levels of uncertainty. Based on the prediction that more successful team performance in joint action will require more coordination of physical movement and social communication when uncertainty is higher (Riley et al., 2011), it can be expected that athlete experience of on-field physical coordination and off-field social interdependence will be salient and meaningful to athlete experience.

I show that, despite strong strategic motivations for adherence to rugby, such as access to coveted life-course opportunities of tertiary education and future employment, athletes are nonetheless captured by the on- and off-field interdependencies that rugby inherently demands. Athletes experience enjoyment, identity, and group membership through rugby. For most athletes, life-course opportunities were at the forefront of their considerations when they first arrived at the Institute, and these considerations continued to motivate their adherence to rugby, at times impacting upon commitment to training and on-field performance. However, I also report evidence to suggest that the interdependence associated with rugby's on-field joint action and off-field social processes of group formation served to reliably capture the attention of almost all athletes who stayed for a period greater than merely a few weeks. As I will explain in full below, many athletes experienced a transformation in which they became "social animals" (*qunti dongwu* 群体动物), both on and off the field.

As outlined in the previous chapter, I suggest that ethnographic evidence presented here is best interpreted using the concept of cultural affordances. The co-existence of various affordances deriving from rugby, contemporary China, and the specific institutional history of rugby and sport in China served to motivate, shape, and constrain athlete experience of joint action. Thus, far from team click or social bonding being absent in this group exercise setting, I suggest that, when

appropriately situated within context, uncertainty, team click, and social bonding will be identifiable and testable. In sum, by describing the contours of uncertainty and coordination in joint action, I am able to render a general account of team click in group exercise empirically testable (Chapter 5).

4.3 Uncertainty and coordination in joint action

In this section, I suggest that athlete experience of uncertainty and coordination in joint action can be inferred based on evidence of athletes' perceptions of joint action. Athletes report that rugby's on-field technical components were a source of difficulty and challenge, which suggested that uncertainty in joint action may be the source of these perceptions. This inference was bolstered by the fact that team performance was on average experienced as more challenging than individual performance (under the assumption that team performance entails higher levels of uncertainty than individual performance, see: Fusaroli et al., 2014). In addition, athletes' reference to the importance of developing on-field awareness in joint action, and the fact that a capacity for on-field awareness appeared to vary with athlete seniority, also suggested that the technical challenges associated with joint action could be mitigated by higher levels of physical coordination.

Despite various competing and interacting motivations for adherence to rugby, the strict parameters of joint action delineated by the standardised sport of rugby are such that the uncertainty of rugby's joint action must be confronted by athletes. As I go on to explain in later sections, for the athletes with whom I conducted research, the unavoidability of on-field uncertainty was accompanied by an unavoidability of off-field social coordination, in the form of processes characteristic of social bonding.

4.3.1 Uncertainty in rugby's joint action

Uncertainty in rugby's joint action was inferred from evidence for athlete perception of difficulty and challenge associated with joint action.

Technical challenge of starting from scratch with rugby

Many athletes reported experiencing rugby's joint action as technically challenging, particularly at the beginning of their rugby careers, when they were forced to "start from scratch." In contrast to professional rugby players of traditional rugby playing nations, who grow up playing rugby from a young age (and thus accumulate technical competence and experience through years of playing and training), the members of the Beijing rugby team were all relatively new to rugby and to team sport more generally. Due to rugby's minnow status in China, most athletes started from scratch when they first arrived at the Institute. Some, like Hongwei, had not seen a rugby ball before they arrived.

Table 4.1 describes athlete attributes such as average age, rugby training age, years spent in the team, and previous sport. The average rugby training age (years spent playing and training in a rugby program, measured at time of semi-structured interview) was 3.34 years (*median* = 3, *range* = 0.16 – 8.00*years*, *SD* = 2.02). The distribution of training age reveals that over half of the sample had a training age of three years or less (see Figure 4.1).

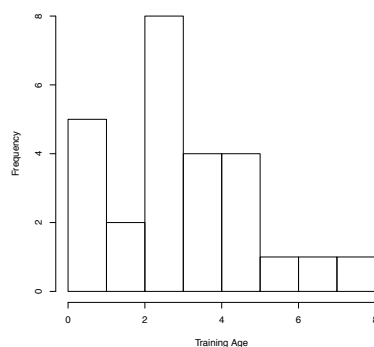


Figure 4.1: Distribution of athlete training age ($n = 26$)

18 of the 26 athletes had a background in other sports (16 athletes from track and field, one from football, one from basketball). These athletes usually began part-time or full-time physical training at the age of 11 to 13. Those who transferred to rugby from other sports did so either at the beginning of senior high school (16 years) or at university age (18 years). The remaining eight athletes had no

Table 4.1: Athlete Descriptives (n = 26)

Variable	Overview
Avg. Years of Age/Experience (sd)	
Age	20.96 (3.17)
Training Age	3.34 (2.02)
Years in Team	2.59 (1.80)
Research Category (%)	
Senior	10 (38.5)
Non-senior	16 (61.5)
Athlete Status (%)	
Master Sportsperson	10 (47.6)
Level 1	6 (28.6)
Level 2	5 (23.8)
Contract Status (%)	
Permanent Employee	1 (3.8)
Full Time Contract	7 (26.9)
Training Contract	5 (19.2)
Student Contract	6 (23.1)
Trial	7 (26.9)
Education Level (%)	
Graduate	1 (3.8)
Undergraduate	12 (46.2)
High School	10 (38.5)
Middle School	3 (11.5)
Home Province (%)	
Shandong	11 (42.3)
Beijing	6 (23.1)
Jiangsu	3 (11.5)
Liaoning	2 (7.7)
Hebei	2 (7.7)
Heilongjiang	1 (3.8)
Fujian	1 (3.8)
Previous Sport (%)	
Athletics	16 (61.5)
None	8 (30.8)
Basketball	1 (3.8)
Football	1 (3.8)

particular sporting background before rugby, and most began adherence to rugby at high school or university age (16—19 years). These athletes were either scouted by the head coach of the rugby Program or by school athletics coaches based on their basic athletic attributes (running speed, strength, coordination, and potential for physical growth).² These data suggest that most athletes had been training for only a short time (relative to other professional rugby players of traditional rugby playing environments), and came with a baseline familiarity with rugby (and team sports more generally) of virtually zero. It is possible that this relative unfamiliarity with rugby's technical requirements can contribute to an explanation of athletes' experience of challenge relating to rugby's joint action.

The most challenging thing about rugby

Athlete descriptions of their perceived challenges of rugby suggested that rugby's joint action was defined by high levels of uncertainty. During semi-interviews, within the general theme of questioning regarding of the motivations for and costs associated with adherence to rugby, I asked athletes what they thought was “the most difficult part of rugby” (你觉得橄榄球最难的一部分是什么?). I deliberately left the question open to interpretation, and if asked to clarify, I followed up by using the compound word *kunan* (困难), to emphasise the challenging dimension of difficulty, i.e. “what is the most *challenging* part of rugby?” (橄榄球最困难的一部分是什么?). In his interview, senior athlete and Beijing local Su Hailiang summed up the feeling of being a new athlete without any foundation in rugby:

I think the hardest thing—well it was all really hard. At the time when I couldn't do anything, when my body development wasn't that good, I wasn't that strong. Basic skills, ball skills, planned moves, etc. [were all not very good].

我觉得最困难的，都挺困难的，当时什么都不会，身体素质也没那么好，没有那么强壮，也没有那么好，身体素质。基本功、球技、记战术什么的。

²Of the 26 athletes in the squad, three junior athletes who were part of the squad when I arrived in September 2015 left before August 2016; and three new athletes arrived during the time I performed research. This flux of athletes in and out of the team was quite common, due to the fact that recruitment often occurred informally via personal networks.

This passage suggests that an athlete's initial induction into the rugby program could be overwhelming due to rugby's many diverse technical requirements. As undergrad Fang Chao explains:

The hardest thing about rugby is all of the small details. Rugby is such a comprehensive sport, and playing in a real game is very different from training. I remember when I was playing a tournament in 2014, at the time I had only just started training (for rugby). As soon as I took the field my whole brain was blank. Now I am a bit better, my vision is broader.

橄榄球最难的一部分是很多小细节吧。橄榄球是很全面的项目，打比赛跟训练还是有区别的。14年的时候打比赛，那时候刚练，一上场整个脑子就空白了，现在会好一点，视野也开阔了。

In his response, Fangchao draws attention to the difficulty associated with the “on-line” and “in-the-moment” demands of joint action in rugby. When he first started playing in real rugby matches, the pressure of being on the field and in the moment meant that there was no time for him to think or see. From these testimonies, it is possible to infer that athlete experience of technical challenge in joint action was due to an underlying quantity of uncertainty, which reduced an athletes' ability to successfully predict, monitor, and sustain joint action.

Team performance was more challenging than individual performance

The suitability of this inference was strengthened by results suggesting that team performance was experienced as more challenging than individual performance. Of the 20 athletes who responded directly to the question of challenge, all 20 interpreted it as a question about rugby's on-field demands.³ 12 athletes cited an aspect of rugby that related to on-field coordination of behaviour that pertained more to coordination with teammates. Six athletes mentioned “awareness” (*yishi* 意识), three talked about on-field coordination with others (*peihe* 配合), two talked about on field decision-making (*panduan nengli* 判断能力), and two talked about planned running lines (*paowei* 跑位) and team moves (*zhanshu* 战术). One mentioned

³In the remaining six interviews, either I forgot to ask this question, or athletes did not respond to the question.

pressure from the coach (*jiaolian* 教练). Six athletes cited an aspect that focussed more predominantly on individual-level components of performance. Four athletes mentioned tackling (*pulou* 扑搂) or individual defence (*geren fangshou* 个人防守), two mentioned individual running speed (*sudu* 速度), and two mentioned footwork in attack (*jiaobu* 脚步). One athlete reported fear of injury as the most difficult aspect about rugby. Two athletes cited both an aspect that was related to coordination of behaviours with others, as well as an aspect of individual performance. These results suggested that athletes experienced a range of specific components as technically challenging, with a tendency to experience on-line coordination with others, or team performance, as the most challenging aspect of rugby.

As outlined in the previous chapter, I employ the terms team performance and individual performance to distinguish two modes of a spectrum of joint action in rugby (see Chapter 3.3). Team performance usually entails joint action that requires attention to coordination with teammates (such as coordination of attack and defensive line, passing between two or more players, etc). Components of individual performance, by contrast, entails attentional focus to individual actions that contribute to larger joint action goals (such as tackling, individual passing, effectiveness in contact encounters at the breakdown, etc.).

The detail of athletes' interview responses to the question of rugby's most difficult aspect suggested that team performance may be experienced as more challenging than individual performance. As Wang Zhenfeng, a tall and extremely talented (but still relatively inexperienced) senior athlete, explained:

For me, it's probably the decision making with ball in hand: after you get the ball, how do you create opportunities for others—I think that's especially difficult. For me, I think breaking the line or attack or whatever...breaking the line or stepping and so on...I'm ok at all of these things [individual components of performance], but if you ask me to create an opportunity for someone else after I have broken the line—that's when I find it difficult.

对我来讲应该是球的分化，拿到球之后分化给别人创造机会我觉得特别难。我觉得突破或进攻还是干嘛的，去突变向什么的对我来说都还好，但是让我即能突然后给别人创造机会我觉得很难。

For Wang, it is not only the on-line and in-the-moment dimensions of rugby that he finds challenging, but also the fact that he must create opportunities for others. Wang Zhankun, a young and promising rugby player from Chaoyang school expressed a similar sentiment:

I'd say the ability to adjust to being on the field in a game. When I'm on the field I can only see those few people who are close to me, when I'm tired I feel like I can't see anything, like there could be a gap, or an opportunity, but often I can't see it.

场上的适应能力吧。我在场上只能看到离自己近的几个人，累的时候感觉看不到所有，可能空档啊、机会啊经常看不到。

These passages taken from semi-structured interviews suggest that rugby's on-field demands in joint action placed severe constraints on athletes' ability to make decisions, particularly in relation to coordinating with the actions and intentions of others. By virtue of the fact that joint action (relative to individual action) entails high levels of uncertainty (Turvey, 1978), and that team performance entails "more-joint" action than individual performance (which is comparatively "less-joint" action), it is possible to infer that athlete perceptions of greater challenge associated with team performance was due to its uncertainty. In other words, levels of perceived technical challenge may vary as a function of uncertainty, with more-joint action entailing higher levels of uncertainty than less-joint action. This inference validates the suggestion, outlined in the previous chapter, that rugby's joint action entails high levels of uncertainty. These results, in turn, validate hypotheses designed to test a general account of team click in this group exercise setting.

Variation in technical competence

While most athletes shared the experience of "starting from scratch" at the beginning of their rugby careers, the Beijing men's team also showed considerable levels of within-group variation in measures that could indicate technical competence or familiarity with rugby's joint action. The team consisted of 13 athletes who were considered "senior athletes" (*lao duiyuan* 老队员; training age = 4.57 SD = 1.65). Of these 13 athletes, eight athletes were considered part of the most senior "starting

team” (*zhudui* 主队), the remaining five were considered part of the “reserves” (*tibu* 替补). Athletes were engaged by the Institute on varying levels of contract: one was a permanent employee (*zhengshi* 正式)⁴ and seven were full time contracted athletes (*xieyi* 协议). The remaining five senior athletes were provisionally contracted on a “training contract” (*shixun* 试训).

The remaining 13 athletes were considered “junior athletes” (*nianqing duiyuan* 年轻队员; training age = 1.91 SD = 1.30). Six junior athletes were engaged by the Institute on “student level” contracts (*erjiban* 二级班), and the remaining seven trained with the program on a “trial” basis (*jixun* 集训); effectively on a trial arrangement until they showed promise or else withdrew from the squad). Athletes contracted as students did not receive a salary but received in-kind support in the form of training, food, board, and health insurance at the Institute.⁵

The Beijing men’s team contained distinct stratification according to training age and seniority, and it was possible that variation in training age and seniority was associated with experiences of uncertainty in joint action. I discuss this possibility in more depth in the following chapter (see Chapter 5.3.1). Here, it is important to note that the sample of athletes with whom I conducted research contained high within-group variation in measures that denote technical competence. This natural variation was useful for the purposes of comparing and contrasting athlete experience of joint action.

In sum, these data confirm the proposal that rugby poses a serious challenge to the goal of successful joint action. Unprompted by suggestions that team performance was inherently more difficult than individual performance, athletes drew attention to the in-the-moment and time-pressured nature of “more-joint” action in rugby (i.e., on-field coordination of team performance). It appears as though, on the field at least, there is no room for thinking. According to athlete testimonies, there appears to be very little room for “seeing,” too. Vision is reduced

⁴Senior athlete Su Hailiang was the only permanent employee, by virtue of the fact that he was a Beijing resident.

⁵Most athletes were from urban and rural areas of northern China (Shandong (11), Beijing (6), Jiangsu (3), Liaoning (2), Hebei (2), Henan (1), Heilongjiang (1))

to the immediate surrounds, and this reduction in awareness constrains the extent to which athletes can identify optimal action selection in multi-agent interaction. Athletes were on average more fixated on the difficulties associated with coordinating with others. Individual level components of performance such as tackling and side stepping were also prominent concerns—and these components shared with team performance an on-line, in-the-moment quality. In addition, athletes suggest that physiological fatigue can also play a role in reducing awareness. Based on the result that on-field *team* performance is perceived as more difficult than other forms of (more individual) action to predict, establish, and sustain, I infer that athletes experience varying levels of uncertainty in rugby's joint action.

4.3.2 On-field awareness as a sign of coordination

Athlete testimonies in interviews suggested that one of the most salient aspects of team performance was the need to develop an ability to cope with the on-line decision making demands of joint action in rugby. Athlete testimonies suggested that one of rugby's biggest challenges was developing the capacity for awareness (*yishi* 意识). The importance of developing awareness was a prominent response to the questions of challenge in rugby. Bao Yuhan, an undergrad and Beijing local, expressed to me his experience of the challenge of awareness on the field:

(I think its about) maintaining continuous on-field awareness. Often I'm never thinking that many steps ahead. Sometimes when I break the line, once I break through I can't keep on going. Suppose like that one time in Shanghai in 2014, I gave the ball to Wang Zhenfeng and he broke through, and then no one followed him. I stood there looking at him run from where I passed the ball, I was so tired I couldn't do anything... As soon as I realised what was happening, I was like "Oh! Quick get after him!" In the end we were one step away—only one step away from losing the ball.

在场上连续意识. 我总是想的不是那么多翻。有时候突破的时候，突破了不会再打。假如在上海14年我给王贞丰突破了，然后没人追上了，我在原地累得不行了看着，我一看，"哦！快追上!"最后差一步，就差一点会丢球。

For Yuhan, awareness appeared to be the secret to overcoming the challenges associated with on-field joint action. Like Wang Zhankun above, Bao Yuhan also suggests that physiological fatigue has an impact on ability to maintain awareness. In addition to the time pressure and cognitive complexity of joint action in rugby, the role of exertion and fatigue may also have been relevant to an ability to think, see, and act clearly on the field (for a discussion of the role of fatigue in processes relevant to team click, see Chapter 6.6).

Evidence suggested that on-field awareness in rugby appears to be inherently difficult. But athletes also suggested that it was something that could improve over time. Senior player Cui Shuocheng, who had recently transferred from Shandong province team to Beijing, compared his relative lack of awareness to foreigners like me who had played the game from a young age:

Right at the start, when I was coming into the team, I couldn't play. I'd often watch the older players playing touch and thought they were so impressive. At the time when I couldn't play at all, I thought everything was such a challenge—when to straighten up my passing line (in attack), when to pass the ball. I would always lose awareness or just always stop. I couldn't compare with you foreigners, you have this awareness from a young age. We have no solid foundation, we all transfer over from individual sports, and so I don't think we get it.

刚开始进队的时候不会打，经常打TOUCH看他们玩，觉得特别帅。当时我不会，当时就觉得特别困难，什么时候插上，什么时候穿球，意识方面老断老断，老停，跟你们老外没法比，你们从小就有这个意识，而我们半路出家，由个人项目到团体项目，觉得不了解。

In his description, Cui Shuocheng suggests that awareness relates to knowing both what action is required at what time. Shuocheng insinuates that such awareness develops over time—preferably from a young age—so that awareness has a chance to become more automatic and immediate. This line of reasoning raises the possibility that athlete experiences of challenge and difficulty in joint action may have been associated with varying levels of familiarity with rugby's technical requirements.

4.4 Motivations for adherence for rugby

As stated above, the general theoretical account of team click in group exercise is predicated on a dynamical link between uncertainty coordination. In other words, uncertainty in joint action will demand coordination—of physical movement and social communication—in order for joint action to occur successfully. The result of better-than-expected joint action, under these conditions, could generate the experience of team click.

The results presented above suggest that athletes experienced rugby's joint action as an inherent challenge. Team performance appears to be more challenging than individual performance, and successful team performance required "awareness"—a seemingly tacit and automatic sense of knowing what to do on the field without having to think about it. I infer from this evidence that both uncertainty and coordination were joint action in rugby is salient to athletes.

In this section, I consider ethnographic evidence for the way in which athlete motivations for adherence to rugby interacted with rugby's on-field joint action demands. As I explain below, deciphering evidence for coordination—of both on-field physical movement and off-field social communication—proved to be an intricate challenge owing to what appeared on the face of things to be competing athlete motivations for adherence to rugby. In essence, evidence suggested that at times, athlete motivation for fostering on-field and off-field (social) coordination was secondary to more personal concerns relating to strategic life-course opportunities and social networks that were external to the team. However, a triangulation of ethnographic data and theory derived from a Chinese relational mode of social cognition helps decipher more nuance in this picture.

I suggest that that motivation for team coordination—both on-field and off-field—existed alongside (possibly competing) motivations for the strategic pursuit of life-course opportunities of education and future employment. But, rather than being understood as directly competing, these varying motivations for joint action can be more productively understood as deriving from cultural affordances that intersect in this particular setting. While almost all athletes arrived at the Institute

with the explicitly-defined motivation of “family and education first; team second,” many left the Institute with a deep, visceral, and socially agentic connection to rugby, their team mates, and coaches.

4.4.1 **Evidence to suggest that personal interests and *guanxi* compromised team coordination**

Various strands of ethnographic evidence suggests that, on the face of things, athlete adherence to rugby was motivated primarily by the pursuit of strategic life-course opportunities of tertiary education and future employment. Evidence from a survey performed after each semi-structured interview revealed that athletes declared their family and pursuit of education as the primary motivations for adherence to rugby.

Upon completion of each semi-structured interview, I asked athletes to participate in an activity in which they ranked (from most important to least important) their motivations for adherence to rugby at the Institute. I selected these motivations based on preliminary unstructured interviews and conversations with athletes, coaches, and other knowledgeable observers. The motivations included: “Education”, “For Beijing”, “Family”, “Gain Respect of Others”, “For Teammates”, “Employment”, “Beijing Residency”, “Money”, “Enjoyment”, “Popularity (with prospective romantic partner).” I wrote each motivation down on a piece of paper and scattered them randomly on the surface of a table in my room where I conducted interviews.

Mean rank of motivations for adherence to rugby revealed a clear trend that family and education were the most prominent motivations for adherence to rugby (see Table 4.2). When asked in semi-structured interviews, almost all athletes agreed that their most prominent explicit motivation for playing rugby was to pursue life-course opportunities of education and employment. Importantly, it was also commonly declared that achieving education and employment through commitment to rugby would make their families proud. In addition, “to gain respect from others” also featured as a prominent motivation—a result that echoed athlete testimonies that rugby was a revered and respected pursuit in their social circles beyond the institute. In this instance, it was difficult to claim that rugby itself

Table 4.2: Athlete motivations recorded following semi-structured interviews (n = 26)

Rank	Motivation	Mean (SD)
1	Family	2.34 (2.35)
2	Education	2.38 (2.19)
3	Respect	3.50 (2.61)
4	Represent Beijing	3.58 (2.04)
5	Employment	3.96 (2.04)
6	Teammates	4.00 (1.94)
7	Enjoyment	5.69 (3.16)
8	Money	5.85 (2.22)
9	Beijing residency	6.42 (2.61)
10	Attract a partner	8.00 (1.41)

was the source of respect from others. While athletes suggested that they were revered by friends for playing rugby, it was likely that reverence was due in part because rugby signalled education, or at least close proximity to the achievement of attending a prestigious university such as BSU.

Very few athletes ranked “enjoyment” as a primary motivation. Whereas, it would not be inconceivable to see this as a strongly cited motivation for adherence to rugby in settings in which rugby exists as a popular mainstream sport. Many, including some professional practitioners would claim to be adhering to a sport like rugby simply “for the love of the game” (Jackson, Ford, Kimiecik, & Marsh, 1998). Money, Beijing residency, and attracting a romantic partner associated with adherence to rugby were all less relevant to athlete concerns. When forced to rank motivations for adherence to rugby, life-course opportunities and family were on average more dominant than motivations driven by team-based categories such as “For Beijing” (4th) or “For Teammates” (6th).

Senior athlete Lu Peng explained to me the prominence of education as a motivation for adherence to rugby:

Yeah, most of us in Shandong are like me, 80-90% are of the same idea: there is an awareness that individual sports need less people, and so coming to rugby this type of team sport, most people's goal is to use rugby to get to university. But when I came to CAU I thought suddenly that I really like this sport, before I had never come into contact with a team sport before, and it was a team sport involving a ball, so I really liked it.

对，因为我们山东大部分人，都是像我这种，百分之八十到九十差不多都是这个思想，就是这么个意识就是说，单项需要人少，所以来橄榄球这类集体项目，大部分目的就是为了上个学。但是来到了农大之后我觉得我突然就喜欢这个项目，以前没接触过集体项目，而且有球的集体项目，所以我很喜欢。

At the same time as citing the more obvious strategic motivation for adhering to rugby, Lu also admits that he immediately came to like and enjoy rugby once he began to train at CAU. I will discuss this feature Lu's testimony—also common to many others—in more detail below. Here, the main point is that the overriding motivation that lands athletes in rugby programs all over China is “family and education” first. These results suggested the possibility that athletes who were more motivated by strategic life-course opportunities and familial social networks beyond the team, may have been less motivated to attend to team concerns, namely, on-field coordination of physical movement and off-field social communication. This possibility, if true, could have implications for a relationship between joint action, team click, and social bonding. In short, a lack of motivation to adhere to rugby on behalf of the team could impact upon a collective ability to reduce uncertainty and increase coordination in on-field performance.

Impact of strategic motivations on performance and mood

In addition to survey data and athlete testimonies in interviews, I also observed a number of instances in which an athlete's mood fluctuated according to the state of their attempts to secure life-course opportunities of education and employment. Often the path to securing entrance to BSU was not always straightforward, even

if athletes had earned the “Master Sportsperson” prerequisite. These examples offered more implicit evidence for athlete motivations that served to triangulate results of the post-interview surveys.

Two senior athletes, Ma Haitao and Cui Suocheng, despite both long qualifying as Master Sportspersons, were involved in complex bureaucratic journeys in an attempt to gain admission to BSU. One day early in my first stretch of ethnography, I was taking a training session in which we were focussing on defence. Shuocheng suddenly appeared to have given up all energy, and all of a sudden he stopped doing the prescribed tackling drill. I took him aside and began to take him through some of the details he missed last week when he was away. He refused to listen and said, “I get it, I just don’t want to do it, I’m sick of it, I’ve had enough of this drill” (我知道怎么练, 我就不想练了。练够了!) “You’ve had enough?” I asked, “Alright, if you’ve had enough then get off the field!” (练够了? 好吧, 那你靠边去!). I snapped at him, motioning to the stands for him to go and sit down. I was stunned Shuocheng said that he didn’t want to practise; I was even more surprised when he immediately followed my instruction and sat on a tackle bag on the side of the training field. Later on in the training session, he came back over to the subsequent training drill and started offering (helpful) advice to the more junior athletes about their technique.

A few days later I found an opportunity on our way back from training to the dormitory to ask head coach Zhu about the situation with Shuocheng. Zhu explained that Shuocheng was experiencing difficulty finalising his contract transfer from Shandong to Beijing province, and that this procedure was interrupting his ability to process his university application (Shuocheng had moved from Shandong provincial team in 2014). To attain prized life-course opportunities through adherence to rugby was obviously a core motivation for most athletes. At times for some, the issue became critical enough to seriously impact on athletes’ on-field performance.

Ma Haitao, another senior athlete also in the process of trying to apply for university (after years of delays), also experienced large amounts of stress during my time conducting research. One day he spoke to me at length about the way

in which these difficulties were impacting on his mood and his ability to focus on training. “It impacts me so strongly” (对我的影响太厉害了) he said as we walked to the canteen after a training session. “I’ll probably need to have a long sleep or take a break from training before I can recover from these sort of frustrations—the endless process of getting this form and completing that form, its so frustrating.”

(我可能要先睡个好觉请假休息才能回复过来呢。这个那个证，跑断腿盖章了，令人太沮丧了。) These examples were representative of many more instances in which it was clear that athletes attended prominently to the education as the primary motivation for adherence to rugby. The goal of gaining entrance to BSU appeared to bear directly upon athlete ability to contribute to the activities of the team, including on-field coordination of movement.

Strategic motivations were used to explain poor on-field performance

Senior athletes and coaches would often appeal to the personal and strategic motivations of more junior athletes as a way of rationalising poor on-field performance. This pattern of behaviour further indicated that athletes’ personal motivations for rugby detracted from team level motivations of collective coordination. Appeal to strategic or personal motivations of more junior athletes were often used by more senior athletes or coaches to explain poor on-field performance. An example of this pattern occurred a few weeks into my first stretch of research.

After a few weeks of observing training and a few sessions in which I myself took the team for training, the different factions in the team became quite clearly expressed on the field. Generally speaking, the trialists were either on the sidelines learning and practising the basics, or very tentatively beginning to join regular team drills in which all other athletes participated. From my position of expertise it was clear to see that, of those athletes who trained regularly, the old-guard of Han Xiaolong and Lu Peng were the most experienced athletes. Below them, the rest of the senior athletes varied in competence according to experience and individual differences, and student athletes from Chaoyang School were noticeably less experienced than their more senior counterparts.

The structure of training drills reflected constraints due to high within-group variation in technical competence. Training drills were usually structured in such a way that athletes of similar abilities almost always trained together in the same subunits, rather than randomly assorting into subunits for each training drill (as was normal practise in rugby training sessions I had become accustomed to outside of China). This tendency to group according to seniority and competence was most obvious in a basic passing drill involving four athletes per subunit (in which athletes would pass the ball between each other while running up and down the field. Usually the most senior four athletes present at that training would naturally form the first subunit, followed by the next most senior (or competent), and so on, until the most junior and least competent or experienced athletes would form a subunit and attempt to emulate the preceding subunits.

When talking to senior players about this custom in training, I was told that the habit was necessary for two reasons. First, given that the differential in ability between the most senior and most junior athlete was so large, sorting according to seniority and competence (as opposed to randomly) ensured that the senior athletes could achieve a basic level of quality in their practise. Second, by sorting together in sub units and doing the drill first, senior athletes could demonstrate the ideal standard for execution of each drill for the rest of the team to emulate. Thus, on-field coordination in joint action appeared to be fundamentally constrained by within-group variation in athlete technical competence.

Interestingly, I began to notice variation in team performance at training according to which athletes (or coaches) were present or absent. After a few weeks of observing training I eventually began to coach the team myself, focussing on defence and “contact” work, and team play.⁶ For the first few weeks, athletes showed obvious dedication and conscientiousness when participating in training and learning the new content that I taught them.

One day, approximately two weeks after I first started coaching the team, I took a session in which for the first time almost all the senior athletes were unable

⁶Contact refers to skills of rugby that involve body-on-body physical contact in addition to defence.

to train, either due to injury or other commitments such as attending BSU for university matters. The impact on the quality of training was palpable. The junior athletes who were present were, for whatever reason, passive and unresponsive to instructions, and appeared unable to provide direction to the athletes below them.

Over the course of my research, a clear pattern emerged, in which the quality of training was more or less correlated with participation of senior athletes. Without senior athletes helping direct training, athletes—particularly the more junior athletes—were generally slower to react to new information.

One day a few weeks after noticing this pattern, I took an opportunity to consult the assistant assistant coach Shi and senior athlete Han Xiaolong about the issue. Coach Shi proposed his opinion on the situation:

Some athletes think its ok to just be an athlete here and get to BSU, and not pursue anything higher or anything more. Actually, it's ok to think like that. But if that's the case then sorry, you'll have to watch from the sidelines.

有的球员觉得好在这当运动员上体大就可以了，不去追求更高的更多的。其实，可以这样想，但是，对不起，你要靠边看着。

When talking to the senior athletes and coaches about the quality of training (or lack thereof), the most problematised of all the team factions was the group of “training contract” athletes, most of whom had just begun their undergraduate studies at BSU (hereafter simply referred to as undergrads). The basic consensus was that these undergrads lacked initiative and focus; they were too distracted by university, computer games, and pursuing romantic love. Having achieved the core goal of gaining access to university, the “unruly undergrads” were often criticised for not possessing sufficient intrinsic motivation and dedication to rugby.

Lu Zhongsheng (“Big Mouth Monkey” (大嘴猴), as he was affectionately known for his gregarious and cheeky personality and his big mouth) produced a similar critique of the team's more junior athletes:

[The problem with the junior athletes is that they are] immature, always thinking that they should be training for us rather than training for themselves. They think: “here I can take a monthly salary of a few

thousand RMB”—they think that just “getting by” is fine. They think, for example, “I have already got in to university, as long as I graduate then I don’t really mind, after all I’ve already made it to university.” This is immature. Wait until the day you become like me and you’ve got nowhere else to go, then you’ll...since you’ve already chosen this sport, then you’ll finally want to work hard at it, to train hard, to achieve some sort of goal. Its like you said [referring to the researcher], they think that if the coach is watching me, then I should train hard; if the coach is not watching me, then I won’t train hard...

Before when I was living with Elder brother Han (Han Xiaolong) in the same dorm room, every night after we would have to hand in our mobile phones, we would talk for ages about these rugby questions. But other teammates maybe aren’t like that, they will probably talk about computer games, girlfriends, or bloody random and unimportant things. They’re always talking about this... If you wanted them to talk about rugby then maybe they’d... I don’t understand it anyway.

心态不成熟，总觉得是为你训练而不是为自己训练，我在这每月拿几千块钱的工资，感觉混一天是一天。比如我已经上学了，只要大学毕业了就无所谓了，反正我已经上学了。还是不够成熟，等到有一天像我一样无路可退的时候就会。。。你既然已经想选择这个项目，你要去努力，好好训练，要做出一种成就。如果像你所说的那样，教练看着我就好好练，教练不看我我就不好好训练...我 以前跟龙哥一屋，每天晚上不是要交手机么，然后我们两个人会谈论很久这些橄榄球的问题。但是别的队员可能不会这样，他们可能就会谈一些游戏啊，女朋友啊，乱七八糟的琐事和小事。他们每天都谈到这个。你要是让他们谈到球可能。。。反正我不理解。

Big Mouth’s rant about the undergrads was representative of many instances in which I observed more senior athletes explain an athlete’s lack of contribution to team performance in terms of a lack of motivation for adherence to team commitment. Here, it is inferred by Lu that the undergraduates lack motivation to contribute to team performance because they are more fixated on the primary motivation of attending (and, it would seem from his descriptions, enjoying!) university.

I return to the nuances associated with rationales for poor team performance in the following chapter (see Chapter 5). For now, suffice to say athletes and coaches alike suggested a relationship between motivation for strategic goals such as attaining education and poor team performance. In effect, these motivations

were assumed to conflict with, and detract from, the motivation for successful team performance, i.e., on-field coordination.

The team as a platform for strategic interests

I noticed a number of instances in which it appeared that the team was used as a platform for strategic interests that ultimately detracted from on-field coordination.

The relatively sudden change in head coach half way through my first stretch of ethnographic research gave me the fortunate opportunity to witness the implications of this transition for the social organisation of the team. When I returned to Beijing after a 10 day travel break in February, almost a month after head coach Wang had replaced former head coach Zhu, two of the athletes who were on trial under Zhu's tenure—Xu Gong and Lian Jianxiang—had since left. When I asked senior athlete Wang Wei about the disappearance of these two students, he suggested that “they had interests with Old Zhu...Old Zhu said that he could solve their “school problems” [i.e. get them into university]. They were here to try to get in to University.” (和老朱有利益关系, 老朱说可以解决上学的问题 都是过来上学的).

Talk of “grey” (*huise* 灰色) arrangements of this nature in sport in China was hushed but common. Another example of this grey phenomenon came one week before the the final National Championship Tournament in July 2016 (the Tournament during which I performed the survey study (Chapter 7) a very large and overweight young man appeared at training. He did not appear to display any direct athletic potential relevant to rugby (he was quite heavy-set and physically undeveloped), and it was also clear that he was completely unfamiliar with rugby. Wang explained to me that this new arrival needed to quickly familiarise himself with rugby, because he was to be named in the Beijing team for the weekend's Tournament. At some point during the Tournament, he was going to take the field, and in so doing, attain the athlete qualification standard of a “Master Sportsperson.” This qualification would enable him to attend the prestigious BSU through the athlete pathway.

This scenario chafed against all of my intuitions about rugby and its institutions. My many years spent playing team sports and absorbing egalitarian and meritocratic cultural narratives common to Western democracies and particularly to my homeland of Australia—the land of the “fair go” and the “tall poppy syndrome.” Here, a young, roughly 17 year old overweight student with no athletic ability and no familiarity with the game of rugby was planning (under the will and organisation of the those who wielded power over the team at the Institute) to take one of the 12 positions available to the Beijing team and play his first (and probably only ever) game of rugby so that he could take the field and therefore receive a passage to a prestigious university. “The Leader has the final say, I can’t do anything about it” (领导说的算, 我没办法) said head coach Wang, helplessly, when I pressed him on it.

When coveted life-course opportunities were at stake, often the interests pertaining to the fostering and cultivation of hierarchically organised and fluid relational networks took precedence over preserving the sanctity of the team as a bounded social category.

Taken together, this evidence suggests that the link between physical and social coordination (as a response to uncertainty) may have been dampened or challenged at times by competing or overriding motivations to pursue strategic life-course opportunities of education, or to attend to more dominant concerns associated with fostering a hierarchical network of relationships (i.e., *guanxi*).

4.4.2 Coordination existed, but in relational terms

Evidence reviewed in the section above suggests that, in the case of the Institute, the foundation of physical and social coordination upon which team click in group exercise is predicated, may have been threatened by strategic life-course motivations of individual athletes. The possible link between uncertainty and coordination in joint action appeared to be at times disrupted by the existence of strategic activities and extra-team priorities. Do these findings suggest that team click was not likely to be found among athletes at the Beijing men’s rugby team? Or, was it possible

that in real world group exercise scenarios such as this one, the relationship between uncertainty and coordination was much more nuanced multi-faceted?

In this section, I review evidence to suggest that concerns for team coordination did exist, and indeed were powerful sources of motivation in spite of (or indeed, alongside) strategic motivations of athletes, coaches, or officials. With the assistance of theory deriving from a relational mode of social cognition (Liu et al., 2009), it is possible to see that concerns for team coordination existed in forms that were more relational than categorical. Re-examined with a relational lens, many *prima-facie* strategic or utilitarian behaviours referred to above can also be understood to contain dimensions of concern for social coordination. As I will explain below in reference to on-field team performance and off-field processes of group membership, the uncertainty of joint action may have been addressed by Beijing athletes in ways that were less immediately obvious to me as a researcher. The consideration of a number of interacting cultural affordances—of rugby, contemporary China, and rugby in China—allows for a more nuanced expectations for athlete experience of joint action.

4.4.2.1 Responsibility for team performance is distributed throughout an hierarchical network of relationships

The application of a relational mode of social cognition to instances of on- and off-field interactions at the Institute allows for a reconceptualisation of coordination in relational (rather than categorical) terms.

To return to the example of poor training performance in the absence of more senior players: I found evidence to suggest that Coach Shi's rationale for junior athletes' lack of motivation may have been insufficient. In particular, it did not take into account the hierarchical and relational structure of on- and off-field activities to which athletes at the Institute were subject. Immediately following Coach Shi's rationale for poor commitment at training, Senior athlete Han Xiaolong offered a different interpretation, by suggesting that the undergrads were becoming habitually un-focussed during training:

It has become a habit. When we were at CAU, at that time during university, we would also lack focus at times and so on, but back then, as soon as head coach Zheng would take training, we would all be immediately focussed!

成为一种惯性，我们在农大那个时候也会不关注等等，但是那个时候郑老师一带我们就全在关注

In fact, Han suggested that junior athletes' lack of focus was due in part to a lack of supervision by an authoritative coach. Coach Zheng was—at the time that Han was referring to—the most authoritative coach in Chinese rugby (see Chapter 3.4.2). The tales of Zheng's intensity as a coach were infamous (see Lu Peng's description of video analysis in Chapter 5.3), and it was clear based on older athletes' recollections that Zheng's presence alone was enough to incite deep, anxiety-induced attention.

Senior athlete Lu Peng, who had also been coached by Zheng Hongjun, shared an exchange that powerfully summarises the agency of the coach in directing behaviour in joint action. At one point in the interview, we arrived at the conversation of the role of the coach in the team, particularly the idea that if athletes relied too much on the coach's direction it could be a detriment to team performance in joint action. Lu reminisced on his time at CAU under the coaching of old Boss of the Beijing team and Chinese rugby, Zheng Hongjun:

...one mistake or a bad decision, say if you didn't pass the ball when you should have, then you'd be taken off. It doesn't matter how well you played before that, one basic mistake, for example, you were under a lot of pressure and you didn't judge the play properly, and you didn't pass the ball, but instead you took the ball forward, maintained possession...I don't think its such a big issue. Its not like we're talking about that type of situation where there is an obvious two-on-one scoring opportunity and you didn't pass the ball (to the open player)... But he (Zheng) won't accept it. If you don't pass the ball (in that situation) he will yell at you, the pressure is extreme. So we became very careful when we played, which developed a terrible habit, which was when—"baaang!"—you dropped the ball. When we made a mistake like that, we obviously knew ourselves that we had made a mistake. But we'd still look to the coach first (so that he could confirm it for us)!

...一点失误或者判断不好不传球就下来，你以前打的再好，一个简单的失误，比如说这个球压力很大。你在场上你美判断好，然后你没

传，但是说我可以向前，保留球权，我觉得问题不是太大。他并不是说想那种很明显的二打一机会我不传... 但是他不行，不传球就骂你，压力非常大，我们打球的时候初伏小心。最后黑的什么习惯：“呗儿”（掉球）。。。我们一失误了自己也知道失误。先看教练！

Over an extended period of close observation, I could not help but develop the impression that—even after “controlling” for within-group variation in competence or utilitarian motivation for adherence to rugby, there was something related to the dominant habits and intuitions of a relational mode of social cognition that helped explain patterns of experience in joint action. Indeed, existing evidence from laboratory settings suggests that the salient processes of hierarchical relationism can modulate patterns of action and perception, as well as modes of self-construal and group formation (see Chapter 3.3.2). Thus, it is plausible to speculate that, in a setting in which hierarchical relationism is most dominant as a mode of social cognition, the presence of figures of authority could be crucial for maintaining the quality of attention and focus in joint action.

Public scrutiny of performance

Observations of the way in which athletes and coaches publically scrutinised the performance of others in joint action contributed to my understanding of a relational mode of coordination in the Beijing men’s rugby team.

I also noticed that, in addition to the coach, senior players also played an important role in the regulation of on-field performance. I often observed high levels of open and public scrutiny of joint action, usually directed from more senior athletes to more junior athletes. For example, usually in instances of poor performance during training, the more senior athletes who were present would often become actively irritated by the poor quality of training, and begin to openly criticise the junior athletes (sometimes, in my eyes, unfairly). It was common to see these senior figures publicly scrutinise the quality of athletes’ joint action in a way that contained no politeness or concern for the way in which the athlete under scrutiny would receive the scrutiny. But, at the same time, rarely did such open scrutiny contain any trace of malice or intent to harm or hurt the other athlete. In situations

in which the relationship was hierarchical, the scrutiny would be received without protest, and the training would continue. At times, when the act of open and public scrutiny of joint action arose between two senior athletes of similar stature, conflict would emerge (for an extended description of an instance of open scrutiny that unfolded among senior athletes at the canteen, see Appendix D.1).

These inferences are in keeping with claims made by a theory of Chinese relational social cognition outlined in Chapter 3. Thus, Shi's explanation that undergraduates lacked motivation due to more dominant concerns elsewhere appears insufficient in its ability to explain the full depth of processes associated with on-field coordination in response to uncertainty. At the same time, athletes subject to a relational mode of social cognition conceivably relied upon "coordination smoothers" for action that were distributed throughout an hierarchical relational network.

4.4.2.2 "I have become a social animal"

Once I realised that physical and social coordination in the Beijing men's team was imbued with a relational logic, the tension between team interests on the one hand, and individual motivations on the other, dissolved. Instead, I was able to conceive of the way in which various interacting cultural affordances shaped experience of joint action. Specifically, I found overwhelming evidence for the way in which the notion of group membership captivated athletes.

In addition to salient relational concerns for on-field coordination, I also found extensive evidence for deep concerns for off-field coordination of social communication, i.e., processes of group membership. During the course of semi-structured interviews, it soon became obvious that the concept of membership to an abstract category such as a sporting "team" was not indigenous to most athletes' experience before arriving at the Institute to play rugby. 17 of the 26 athletes included in the final analysis had transferred to rugby from other sports: 15 from athletics, one from football and one from basketball. The remaining nine athletes had no specific background in sport before arriving at the Institute. When I asked athletes what new things they had learnt from rugby, one overwhelming response was "team

awareness” (团队意识). Meanwhile, “team spirit” (*tuandui jingshen* 团队精神) and “team work” (*tuandui peihe* 团队配合) were commonly invoked by senior athletes and coaches as ideal ethics of group membership for the rugby team. For the majority of athletes who came from the individual sport of athletics (and the athletes with no prior team sport background), the team dimension of rugby was a distinctly novel experience, involving a suite of new social norms and requirements associated with group membership.

It appeared that many junior athletes experienced team membership as a fresh, exciting, and meaningful experience. Guo Junping, the youngest and most recent of the arrivals to the program during my time conducting research, had very little to say during our interview. He did, however, comment enthusiastically on the novelty of “team:” “It was only when I started playing rugby that I knew what a team was, before when training for athletics (everyone) liked to do it on your own!” (练的时候才知道团队，以前练田径的时候都喜欢自己一个人单干!) Lian Jianxiang, a young triathlete at the Institute, went into more detail:

Before I wasn't used to it, and then later as began to interact with my senior teammates, I discovered that it was more or less the same as my previous (athletics) team, but just more cohesive. But there was still a difference, for example in an individual sport you need to manage yourself and that's all, whereas team sports you need to consider more, you need to consider a lot of things that relate to everyone...[By now] I am used to it. I like this feeling [of team sport membership] more, its so much better than individual sport, in an individual sport its just yourself, its too independent. This (rugby) is a big family, isn't it?

之前不适应，后来和师兄一接触发现和我之前的队也差不多，要团结。但还是有差别的比如说之前个人项目管好自己就行了，团体项目考虑的比较多，要考虑好多大家一起的东西...习惯了。更喜欢这个感觉，比个人好太多了，个人只不过自己，个人项目太独立了，这个是个大家么

Undergrad Fang Chao explains how he was transformed by rugby and the team:

I think before when I was doing athletics, compared to now, I think I am no longer the same person. When I first came into contact with rugby, before I was doing an individual sport. Now this is a team sport. I've

changed a lot in terms of my personality, before when doing athletics I thought I was very independent and self-reliant, my own person. Now I am one person who needs to communicate a lot with other people, cooperate; I have become a social animal.

我觉得之前练田径，跟现在橄榄球比，觉得我完全不是同一个人了。橄榄球刚开始接触的时候，之前田径是个人项目，现在是团队项目。性格方便改变很多，之前练田径是觉得我是个我行我素，自己一个人，现在我一个人还需要和别人多沟通，合作，变成群恤动物。

It appeared that with new on-field technical requirements for coordinating physical movement also came new off-field strategies for coordinating social communication. For many more junior athletes, the team appeared to be a fresh and exciting construct that entailed high levels of perceived interdependence with teammates.

For many athletes, rugby was not just fresh and enjoyable, but also appeared to be a construct that afforded rich social meaning and personal identity. I found this particularly to be the case with more senior athletes. Senior athlete Ma Haitao, for example, explained to me the development of his feelings of belonging to the team:

When I first came my sense of belonging was not strong, in terms of joining the Beijing team, because I didn't have anything, I couldn't play! I wasn't playing with the team, I wasn't anything. At the time in my heart I felt, being a Beijing team member means going out and representing Beijing in a tournament. If you haven't represented Beijing then I felt like I hadn't made a contribution, I could say to myself that I was part of the team, but I couldn't actually recognise myself as being part of the Beijing team. Now, last year when I played in a tournament, now I have that recognition. "Are you in the Beijing team? Have you played in a tournament?" (If the answer to these questions is) no, then I don't recognise it myself. Only last year after playing a Tournament did I slowly start recognising that I was part of Beijing team.

刚来的时候归属感不强，就加入北京队，因为什么都没有，啥都不会，没跟着一块打球，什么都不是。当时心里觉得什么是北京队，就是出去代表北京队比赛。没代表北京队就感觉自己也没为北京队做过贡献，说自己是北京队，自己都不认可自己是北京的。现在去年打比赛了，才对自己有认可。“你是北京队么？比过赛么？”没有。自己不认可。去年打完比赛才慢慢开始自己认可。

Ma explained that his ability to equate his personal identity with that of the Beijing team was contingent on him representing Beijing in national tournaments—before doing so he “was nothing.” It is interesting to note that for Ma, concrete

on-field actions (taking the field for Beijing) signal authentic group membership. Without the proven technical competence required to take the field for Beijing in a national tournament, Ma was unable to subscribe to Beijing rugby as a core personal identity. This example is striking as an indication of the intensity with which athletes identified with team membership.

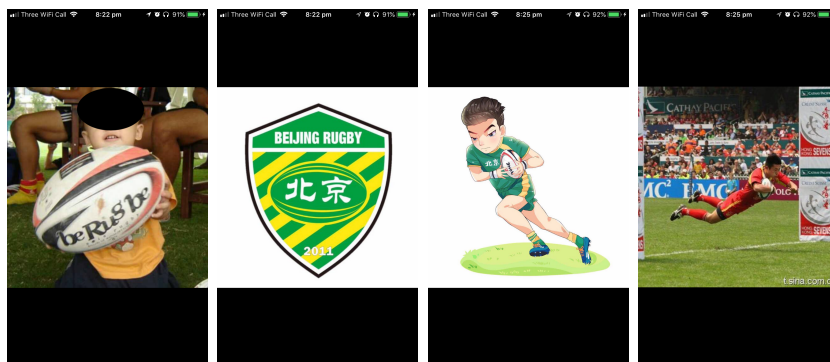


Figure 4.2: Screen shots taken from the social media profiles of a selection of athletes

In addition to these explicit declarations recorded in interview settings, athletes' identification with the team and with rugby was evident from their use of other communication platforms. Social media, for example, was a highly visible forum in which athletes would signal their social identity to friends and family. Both junior and senior athletes would display their connection to rugby on their individual WeChat accounts, by either changing their alias to include some reference to "rugby" or their profile picture, to display a photo of a rugby ball or a famous rugby player (see Figure 4.2).⁷

Taken together, this evidence suggests that, despite strategic and particularistic concerns of athletes to their respective relational networks beyond the rugby team at the Institute, the rugby team at the Institute was a salient and meaningful construct form which athletes derived rich personal and social resources.

Among the most senior athletes, I noticed almost complete alignment between personal and social identity. Of all the athletes included in my analysis, senior athlete and team captain Han Xiaolong was perhaps the most explicit about the

⁷WeChat is an online messaging and social networking platform that has become a near-universal means of electronic communication in Mainland China (an English language/Western equivalent would be something of a cross between Facebook and WhatsApp Messenger)

way in which rugby functioned as his social identity. Han was the most experienced athlete and was also in a position in which he was uncertain about his future. What was certain, to Han at least, was that the only skills and resources he had to face the future were associated with rugby.

When I first arrived at the Institute, not knowing the details of the politics of the situation, I asked him what he was going to do next after the 2017 National Games. Han smiled at me, recognising that at that time I had no idea about the details of his situation with the Leadership of the Institute. “I don’t know yet” Han said to me, “But all I know is that I just want to do this (rugby)” (还没确定呢，我就想干这个). Later in our semi-structured interview, Han explained his relationship to rugby in more detail:

HXL: I think its like this: as long as I like something, then I’m willing to commit to it. And then I might get injured, or let myself get tired and fatigued or whatever, but I think “I really like this sport, I am willing to do it.”

JT: And once you come to like (rugby), these costs don’t count as...

HXL: Once you come to like rugby you’re willing to invest a lot in it

HXL: 我觉得是这样，只要我喜欢这个东西，我就愿意去付出，然后可能会受伤啊、或者让自己很累很疲惫什么的，但是我觉得我挺喜欢这个项目，我愿意去做。

JT: 喜欢了之后，这些成本不算...

HXL: 喜欢之后可以付出很多.

Han’s relationship to rugby represents another stage in the progression from a complete novice like Hongwei to rugby master like Han. Han communicated a realisation that his personal and social identity were aligned in a 1:1 ratio with rugby. It is important to note that these declarations of team membership should not be construed as pure commitment to the team for the team’s sake. In these instances, it was also clear that Ma and Han were both deeply motivated by personal strategic interests. For Ma, playing a national tournament for Beijing also meant qualifying for a spot at BSU, while for Han, continuing to adhere to rugby at the Institute would necessitate that he became a full-time employee of the Institute. Thus, various cultural affordances operated in concert to shape patterns of experience of rugby’s joint action.

4.4.2.3 The team was a relational construct

While the team was a salient construct for athletes, it was clear that the team did not function to organise physical movement and social communication in the ways that I had come to expect in teams that I had occupied previously. Over time, I discovered that the team was imbued with a relational logic: it was understood to be hierarchical, distributed throughout people and spaces beyond the 26 athletes, and it was understood to require an ethic of personal-cultivation in order to sustain and enhance membership. Understanding of the relational logic of social coordination at the Institute helped me understand that, at times, what appeared to be actions motivated by self-interest were in fact deeply social in nature.

Team as family, teammates as brothers

The concept of “family” was central to the rugby program’s public discourses surrounding social norms of group membership. From vice-principal Jenny, to the head coaches, and the athletes themselves, family was the metaphor most commonly used to convey the requirements of each athlete to their team. More so than the egalitarian construct of team, the metaphor of family contained room for expressing both the solidarity and emotional support of shared membership, as well as a justification for the hierarchical structure of the group. Thus, while the notion of the team was salient in athlete experience, it also appeared that the team may have been construed in relational terms more closely resembling an hierarchical family. The prominence of conventions associated with family were identifiable in the naming conventions of the team. As a general rule, when directly addressing elder athletes, an athlete would add the suffix “*ge*” (哥) to the elder athlete’s first or last name, to indicate that the elder athlete was relationally equivalent to an elder brother. When addressing Han Xiaolong, the most senior athlete in the group, for example, athletes would commonly use *Long Ge* (龙哥). When referring to the coach, on the other hand, athletes would use either the formal and respectful “Teacher” (*Laoshi* 老师), “Coach” (*jiaolian* 教练), or the more colloquial suffix abbreviation of *dao* (导). The naming conventions for the coach

conventions for the coach derived from a Confucian tradition of master-apprentice relationships—originally structured on familial relationship conventions (Spence, 1990). When referring to a teammate in the third person, athletes would often refer to them as either their senior apprentice *Shige* (师哥) or junior apprentice *Shidi* (师弟), depending on whether the teammate was older or younger. The network of relationships of the rugby team were thus modelled using hierarchical familial and Confucian master-apprentice relational conventions.

Senior athlete Wang Wei offered his perspective on the family-like structure of the rugby program at the Institute

Its not as if there was not a lot of new stuff, because I guess at the time I was playing basketball—basketball is also a team sport. But the only little bit that rugby made me experience was respect for elders, newcomers must respect senior team members, senior members must take care of junior team members, this is something that I didn't experience in basketball. At the time also I didn't understand that much, I guess China has always had respect for elders, but it didn't come up for me in basketball, and so then when I came to rugby my experience of it was very deep.

那倒没有很多，因为我当时打篮球嘛。篮球也是集体项目但是唯一一点和橄榄球比让我体会到就是长幼尊卑，新人得尊重老队员，老队员得关照小队员，这是我在篮球上面没体会过的。当时也没了解这么多，中国文化一直有尊老爱幼嘛，在篮球队没体现过，然后到橄榄球队还是体验特深的。

Wang Wei first arrived at the Institute in 2011, during a time when the range in ages of athletes at the program would have been quite extreme, with the youngest athletes being around 16 years old, and the oldest athletes being in their mid 30s (the age range of athletes during my research was 15-28 years). The hierarchical and relational conventions associated with family functioned as a resource that enabled Wang Wei to navigate the social terrain of group membership in which within-group variation in seniority and experience were high.

Family was also commonly deployed by coaches and the Institute leadership to convey ethics of team commitment. In an official team meeting approximately two months into my first stint of fieldwork, vice principal Jenny provided the most elegant and articulate example of discursively framing the group as a family.

...I very much welcome everyone to join the Institute's rugby team. I also hope that in study, living, and training, everyone will treat each other like their own siblings, with mutual tolerance and understanding. I hope you are able to create a very good team atmosphere, and it is by no means easy, because everyone comes from all corners of the world. Everyone is an independent individual, more or less autonomous, prone to be relatively selfish, and may also have poor self-management skills. But this all changes when everyone comes to this big family, because rugby is a team sport. In a team sport, everyone in the team needs to be twisted together into one single rope in order for that rope to send out a force. I don't wish to see cliques of twos and threes; or see you take the field with seven hearts, or with five hearts—rugby doesn't work like that. I wish that [when you take the field] everyone shares only one heart. Only in this way will our team be able to achieve good results.

...非常欢迎大家加入橄榄球的队伍，也希望在以后学习生活训练过程中希望大家像亲兄弟姐妹一样，互相宽容互相帮助互相体谅，能够形容一个非常好的气氛，因为大家来自五湖四海，非常不容易。每个人都是独立的个体，多多少少都比较自主、比较自私、可能自我管理能力较差。来到这个大家庭之后，因为橄榄球是个团体的项目、团队的项目，需要大家队伍要拧成一股绳，发出一股力。我不希望大家三个一群两个一伙，上场之后七条心、五条心、不是这样。我只希望大家一条心。只有这样我们队伍才能打出好成绩。

Taken together, these excerpts suggest that the concept of family contained dual affordances for processes of group membership. On the one hand, the family represents a group in which every member contributes to and receives collective strength and support, by virtue of the solidarity achieved through group membership. On the other hand, the family entails hierarchy. In the formal setting of the team meeting, Jenny emphasised the former dimension of the family. But it was clear from behaviours in less formal settings that the family also afforded attention to fostering hierarchy in the team, whereby some individuals enjoyed privileged access to shared resources by virtue of their seniority. The concept of team and its associated egalitarian ethics were, by contrast, insufficient as affordances for explicitly representing and navigating the dominant mode of hierarchical relationism at the Institute, and in a Chinese relational mode of social cognition more generally.

4.4.2.4 The “I” in team

In addition to emphases on hierarchical relationism in group membership, it became apparent that athletes also emphasised personal cultivation as a means to demonstrate team commitment. As explained in Chapter 3, a relational mode of group membership will not always predict deference to others. In particular, a Chinese relational mode of social cognition predicts that personal cultivation is an equally important component to group membership.

I noticed various instances in which athletes opted to promote the self in social settings as an ethic of group membership. My realisation of this pattern started during interviews, when I would ask about each athletes’ journey to rugby. Although athletes would recognise in passing the agency of their coach or close relation who facilitated their journey to the Institute, when I asked whose final decision it was to play rugby, almost all athletes would emphasise that coming to the Institute was ultimately their own personal decision. Often this personal agency was made in counter-distinction to their parent’s will.

Senior athlete, Ma Haitao, after explaining how he had been introduced to rugby via one of his family friends (who had attended CAU), explained how he came to the decision to play rugby:

My Father didn’t know this sport. Because in China very rarely will people know what [rugby] is, so my Parents didn’t know. From a young age I’ve been away from home playing sport, and so generally I decide these things myself...I made the decision myself. At the time I arrived wheeling a suitcase and had a bag on my back. I came at the time with a classmate...

我爸不知道这个项目。因为中国很少知道有这个，他们不知道。我从小就在外面练体育，所以我一般是自己决定这些东西...自己决定的。当时自己背个包投的箱子来。当时和一个同学，他是农大的。

While not wanting to discount the possibility that Ma’s was completely independent in his decisions, it is obvious that Ma’s account involves a deliberate emphasis on personal agency, even though at the time to which he was referring he would have still been a legal minor and completely dependent in financial and other senses to his legal guardians (his parents and coaches).

Meng Cheng, a junior aspiring athlete from Beijing's outer suburbs was even more proud that the decision to play rugby was his own:

My parents at the time thought [rugby] was quite dangerous, and they didn't let me play. But they weren't as stubborn as I was. It's the case with everything, I decide...If I to do something I have to make the decision myself, and then no one can change my decision...

父母当时觉得很危险，不让我练。但是拗不过我，他什么事都。我自己决定了...就是说我拿什么我一定拿的主意，任何人改变不了...

Pan Qiyu, a senior athlete and CAU graduate from Dandong in Liaoning province, also had a similar story about self-determination when I asked him about his decision to play rugby:

I decided myself...How I came to the decision was actually quite interesting. At the time when we first came in it was really difficult. At the time forty or more of us were selected, but many people wouldn't let us train, including our head teacher at high school. A lot of class teachers said to me that there was no hope for rugby, rugby in China has no development [potential], and there are barely any universities that you can attend [through their rugby programs]. And so then they wouldn't let us (the students who selected rugby) train, only us! After that I said to my Mum and Dad that I really liked this sport, and then my parents also extremely supported me with this. When I got in to CAU (through their rugby program) my parents were extremely supportive.

我自己做的决定...决定特别有意思。当时我们进来的时候特别艰难，当时我们选了四十多个人，好多人不让我们练，包括我们的班主任，好多授课老师跟我说没什么希望，橄榄球在中国没有什么发展，也没有几所大学能上。然后不让我们练，就——我们！后来我就跟我爸妈说我特别喜欢这个项目，然后我爸妈也非常支持我，我靠农大的时候他们非常支持我。

The pattern of athletes emphasising their own determination in the decision to play rugby was striking, particularly when combined with the fact that almost all athletes also mentioned—more incidentally and as matter-of-fact—that their coaches played some sort of role in facilitating the opportunity to play rugby. In other words, it was unlikely that these individuals were the sole determiners of the decision. It was clear that there was some social utility to emphasising self-determination, as if it was an important virtue of group membership.

The virtue of self-determination and self-reliance was powerfully illustrated to me outside the context of the Institute, when I agreed to help out CAU coach (and China's most famous rugby player Johnny Zhang) by agreeing to take a rugby session with a group of young school children (aged between six and eight years).

The training session was designed to be explicitly educational, and so I felt that I should attempt to tie some of the elements of team work in rugby to virtues of friendship and cooperation. Towards the end of the session, when trying to emphasise the importance of teamwork in a team relay drill, I asked the children: "Who do you rely on most in this life?" (你在生活中最依赖谁?). I was hoping that this question would naturally prompt the answer that they had to rely most on their family and friends for support—what I thought was a relatively obvious response in either a Confucian or Anglo-Protestant system of ethics!). To my surprise, a chorus of two or three more outspoken children responded, instead: "Myself!" (自己!) We rely most in life on the self, these kids insisted. Self-reliance was not the reply I was looking for, but it did say something about the emphasis on self-reliance as an important virtue of group membership. Indeed, consultation of Chinese indigenous psychology reveals that personal cultivation is a central virtue in a Confucian system of ethics, and is a central resource necessary to foster viable social relationships (Liu, 2014).

The active cultivation of the self was a recurrent theme in interviews with athletes when asking about their role in the team and how they ought best contribute to the team. As undergrad Hou Siqi explained when I asked him if he considered his teammates as an important part of his motivations for adherence to rugby:

I think about them (teammates) little bit, but I think after all the main thing is to make sure you do a good job your self. When you're looking after your self that can be a foundation on which to consider others.

有一点，但是我觉得我毕竟是主要还是想把自己做好，做好自己的基础上为再考虑大家。

When I asked another undergrad, Fang Chao, about his perceived role in the team, and what he ought to focus on, he responded that he "hadn't thought that

much about it, I just want to make sure I play well myself, ensure that I personally train hard” (我没想那么多，就想自己把球打好，自己好好练).

In all of these instances, personal cultivation appears to function as an ethic of group membership. Taken together, this evidence suggests that promotion of the “I” in team serves a deeply social function.

4.5 Discussion

In this chapter, I propose that athlete experiences of uncertainty and coordination are present and salient in the Beijing men’s rugby team. If accurate, this proposal should also suggest that team click will be associated with higher levels of physical and social coordination in response to higher levels of uncertainty. The key aim of this chapter was to identify the contextual contours of athletes’ experience of uncertainty and coordination, so that key variables of interest to a general account of team click could be located.

Ethnographic evidence reported in this chapter demonstrated that diverse cultural processes can act as affordances that shape athlete perceptions of joint action. Athletes appeared to navigate the challenges of on- and off-field coordination through recourse to a dominant relational mode of social cognition. As a researcher not indigenous to this mode of social interaction, I often experienced group processes as jarring and counter-intuitive. But, over time, I learned that processes of coordination were imbued with a deeply social logic, of which athletes’ strategic pursuit of life-course opportunities of education, concerns for relational *guanxi* networks, and an ethics of personal cultivation were all constituent and interactive components. Thus, I inferred, athlete experience of uncertainty and coordination in joint action were both present and salient, albeit in terms that represent a relational mode of social cognition. The theory of cultural affordances (Ramstead et al., 2016), allowed me to locate a relationship between uncertainty and coordination, upon which the general account of team click is grounded. In effect, I inferred from ethnographic data that affordances pertaining to rugby’s joint action parameters, and China’s

contemporary mode of relational cognition both enabled and constrained specific physical and social patterns of coping with uncertainty.

By way of concluding this chapter, I return to the team banquet (see Section 4.1). The prominence of personal cultivation as a social virtue was performed at a team dinner held on a Sunday night a few weeks after Wang took the reigns as head coach. Han's speech appeared to me to be a deeply self-promotional act. But, upon reflection, this interpretation was generated from my inherently categorical intuitions concerning social processes such as group membership. Considered from the perspective of a dominant Chinese relational mode of social cognition, Han's speech can be interpreted as deeply prosocial, as its content expressed that he was upholding his part in the system of hierarchically structured relationships that included—but was not strictly limited to—teammates in the Beijing men's rugby team. In this way, Han's dream was the group's dream, and thus Han's prosociality needed not to be mediated through reference to the category of team or egalitarian membership to that category (Liu et al., 2009).

This is not to say that identification with social categories such as the team were not meaningful or functional in processes of group membership. It was clear that they were. Later in the evening, as the speeches progressed around the table, I did hear some of the more junior senior players make reference to team ideals. CAU graduate Pan Qiyu suggested in his speech that “we all need to put ourselves after the team; this is a team sport” (我们都有把自己放在团队之下); and old head Wang Wei: “this is a team sport; team first, self second” (这是个团队项目。团队第一，自己第二). Importantly, however, these assertions were not egalitarian in their essence, and instead suggested an individual subservience to the team, rather than an egalitarian, shared ownership of the team by each of its members (a more common notion expressed in Western team sport contexts that I have been a part of previously).

Indeed, when Pan and Wang were referring to the team, it could be assumed that what they had in mind was a relational network of individuals structured in a fashion that mirrored the seating arrangement. On one level, the team was

united together as equals: all of its members sat at a round banquet table in which everyone had a seat. But on another level, this circle was imbued with a hierarchical structure through which relations of power that flowed from the coach at one end to the most tenuous and junior athlete sat nervously awaiting orders at the other end.

Within these multidimensional parameters, a wealth of affordances shaped athletes experience of uncertainty and coordination of joint action. In the next chapter, I use this contextual platform to help identify how athletes experience joint action, team click, and social bonding.

5

Team click in context

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Early in my first stretch of research, I accompanied the team to the annual Beijing 10s Rugby Tournament, which was attended by the Beijing Team and the three other expat rugby clubs based in Beijing. In the final match of the day, the Beijing men's team were playing the Beijing Devils Team (Devils). In the first half, tensions began to simmer between the two teams due to a late tackle made on a Beijing player by a Devils player. When the Beijing player took offence to the late tackle, it sparked a disruption in play, as other players from both teams came in to support their teammate. This scuffle drew immediate and instinctual response from where I stood with the non-playing Beijing team members on the sideline. A

few of the reserves on the Beijing team dropped their water bottles and began to run onto the pitch in solidarity with their teammates. Play eventually continued, but tensions between the two sides persisted for the duration of the match.

With only one minute left to play, the scores were locked at 10 points each. Amazingly for Beijing, senior athlete Wei Wenxin pounced on possession of the ball and beat a series of defenders to score a try under the posts to win the match. Wenxin was elated, as were his teammates, including those of us on the sideline. As soon as he put the ball down over the try-line, he turned around to the Beijing Devils team chasing after him and screamed out (in English) “Fuck!” while making a grand and aggressive upper-cut movement pointing his index finger in to the air to signal triumph.

Wenxin was obviously elated with victory, as were his teammates. And, while most of his teammates thought that his choice of word was a little bit crass (I think he may have been trying to express a more celebratory “Fuck yeah!”), they all seemed to resonate emotionally with his sentiment. This instance of emotional support between athletes during and after high stakes competition made it clear that there was something important about joint action that unfolded under conditions of high-stakes and high uncertainty. In this case, the source of euphoria came in large part from the fact that the team shared in victory. But, I also wondered to what extent did the effortless “click” of Wei Wenxin’s physical actions—prior to his victory cry!—contributed to a sense of togetherness following the Tournament.

5.1 Team click in context

In this chapter I consider ethnographic evidence that bears upon the research hypotheses set out in this thesis concerning a general account of team click. In particular, I ask two main questions. First, and most critically, do athletes experience team click? If so, how do they talk about it, and with what do they associate it? Second, how do athletes experience joint action in this particular group exercise context? How do athletes perceive on-field performance in joint action, and what role does uncertainty and expectation violation appear to play in these processes?

Answers to first question allow me to assess the validity of the core hypothesis of this thesis (H1), that team click mediates a relationship between perceptions of team performance and social bonding. In particular, I attend to evidence that suggests a relationship between more positive perceptions of team performance and perceptions of viscosity and social agency. In addition, I identify the ways in which team click appears to set a physically embodied and socially embedded foundation for perceptions characteristic of social bonding.

Answers to the second question allow me to dig deeper into the component mechanisms of the phenomenon of team click. Particularly, I consider whether higher levels of uncertainty in joint action generate higher levels of team click and social bonding (H2), by generating more positive violations of expectations concerning team performance (H2a and H2b).

In addition to these core considerations, I remain mindful of the possibility that hypothesised relationships may vary according to individual differences such as technical competence and personality type (Research Question 3, see Chapter 1.5.1). These considerations are of particular relevance this specific group exercise setting in which variation in experience and familiarity with rugby varies markedly within a relatively small sample of athletes. As discussed in Chapter 4, the Beijing men's team was made up of a stratum of athletes, from an old guard with a professional training age of 7-8 years, to those new comers who had only just arrived at the Institute.

5.2 Do athletes experience team click?

Ethnographic results clearly suggest that team click was a highly present and commonly perceived phenomenon. In semi-structured interviews, I began the conversation around team click by asking each athlete directly about his perceptions of *moqi*. As mentioned in the introduction Chapter 3, *moqi* refers to the perception of tacit understanding between two or more co-actors in joint action, and is a term that most closely resembles the use of the English term “click” to describe optimal coordination in joint action. Thus, while the concept of team click encompasses more components than just tacit understanding alone, *moqi* offered the most direct way

in which to initiate a conversation about team click with athletes in semi-structured interviews. In this chapter, unless I otherwise specify a narrow definition of *moqi* as tacit understanding, I use the term in its broader colloquial sense, as a concept equivalent and interchangeable with team click.

Each time I first asked about *moqi* I deliberately qualified the question by specifying perceptions of on-field coordination of joint action (场上的配合). This allowed me to encourage reflections based specifically on on-field joint action, more so than other (off-field) team settings in which “click” in non-rugby joint action may also have occurred. Of the 26 athletes included in my final analysis, all 26 acknowledged the phenomenon of *moqi* and its relevance to joint action in rugby in semi-structured interviews. Not all athletes were necessarily able to recount particularly deep or personal experiences of the phenomenon, and many more junior athletes admitted humbly that they were personally unfamiliar with what the experience entailed. Nonetheless, the overwhelming and complete recognition of the relevance of *moqi* to rugby was reason to pursue an investigation into the role of team click in this group exercise setting.

5.2.1 Team click involves experiences of viscosity and social agency

In line with existing relevant literature reviewed in Chapter 2, athletes described *moqi* as involving both visceral and agentic dimensions. In terms of viscosity, athletes drew attention to the unspoken, implicit, and atmospheric qualities of *moqi*. At the same time, these descriptions also contained either a blurring of the lines of self and other, or inference that agency is shared between co-actors. Below I select some representative examples of each of these qualities of *moqi*.

Senior athlete Cui Shuocheng reminisced to me about his feeling of tacit understanding with teammates in Shandong province (before he transferred to the Beijing team):

Its like when you're moving the ball [either passing and catching it]: when the ball-carrier gets there [indicating to the space in front of us in the interview room] the next person just knows what to do, like he

takes just one look or something and everything just moves, they both know what to do.

当你传球和接球的时候下个人就知道做什么，好像一个眼神或者一个什么就动了，知道怎么做。

Here, Cui draws attention to the fact that *moqi* in joint action appears to involve a tacit, unspoken understanding between co-actors in which coordination is achieved without needing to articulate anything explicitly—co-actors “just know what to do.” Following his description of tacit understanding between athletes in Shandong, Cui Shuocheng then reflected on why *moqi* was less present in his experiences in Beijing: “I feel that in Beijing (we) play too singularly, its just that type of ‘pass the ball, pass the ball’” (感觉在北京打得太单一，就是传球传球之类的). Cui’s contrasting evaluations between teams draws attention to the fact that the experience of *moqi* may also contain—in addition to its visceral dimension—a process of attributing social agency—either to others or generalised to a collective (in this case Beijing vs Shandong).

When I asked senior athlete Wang Wei about *moqi*, he drew attention to a more personal experience of flow, coherence, and control in joint action:

It feels like the ball in your hand is listening to what you say, it will go wherever you want it to go, whatever you say the ball should do, where it should run, then the ball will go there. Its the feeling that this defender is standing there looking at you and not moving, the whole process flows like clouds or water).

感觉球在手里特别听你的话，你要他去哪就去哪，你说这个球该怎么，该往哪跑，这个球奔哪去。感觉这个防守站在那看着不动。你整个过程行云流水。

Wang Wei’s description of his perception of action is vivid, and indicates both a feeling of control over action, as well as surrendering of personal control to the agency of the “process” of the action itself. When I asked senior athlete Han Xiaolong to comment about *moqi*, he drew attention to the idea of team atmosphere (*qifen* 气氛), or what he insisted on distinguishing as “team aura” (*qichang* 气场) due to the capacity of aura to delineate atmosphere located around a specific entity (i.e., the team):

[Tacit understanding comes from] team cohesion. It's just team unity, the aura that arises from team unity. It's like: look, suppose that you are an outsider, and then we are a team, and we're all really cohesive, we are all positive, unified, and improving together in training, and then you can feel it from outside. That type of feeling: that's team aura!

团队凝聚力。就是团结，团结起来的气场。就是，你看，你是一个外人，然后我们这是一团队，然后我们都特别团结，大家都积极向上，相互包容，相互练习进步，然后你从旁边就能感受到。那种感觉：气场！

Han draws attention to the idea that aura is something that can be felt from both within and outside the team, by participants and observers. Han also draws attention to the fact that atmosphere is contingent on related concepts, such as unity, cohesion, and shared positivity—all of which suggest collective agency in causing, controlling, or contributing to team performance in joint action.

In similar fashion to Cui's comments about tacit understanding above, athletes also chose to reflect on team atmosphere by talking about its lack in the current Beijing team. Beijing local Meng Cheng was a recent arrival to the Institute from the Chaoyang School (a feeder school to the Institute). He explained to me the problem with the team atmosphere at the Institute:

When we were at Chaoyang we really had that feeling of unity, everyone in it together, for better or for worse. As we'd improve we wouldn't focus on who was suddenly improving (more than others), we'd do more or less hand in hand. The atmosphere [at the Institute] is a bit off...its different from Chao Yang. What I mean is that type of feeling when you drink sweet coffee and when you drink bitter coffee...its due to the relationship between junior and senior players: I feel that there is a gap. Maybe its because of how hard it is here to play yourself into a starting position—the junior players lose a bit of hope.

我们在朝阳的时候特别有，大家会一起，有难同当，进步也不会说谁突然就比大家进步太多，都是基本齐头并进。

气氛会变点味，跟朝阳不一样。变点味就是你喝甜咖啡和苦咖啡的那种感觉。师哥师弟的关系吧，感觉有一个隔阂，因为你拿这个位置的主力觉得太难太难了，或者在队里拿一个打比赛的机会觉得太难了，有点绝望。

Team atmosphere—of both sweet and bitter brews—commonly featured in athlete explanations of their experience of on-field *moqi*. These terms facilitated the conceptualisation of a latent or tacit feeling regarding ultimate coordination in joint action that athletes found difficult to articulate via more mundane rationales.

In addition to tacit understanding and atmosphere, athletes also suggested that *moqi* involved a recognition of interdependence and reliability between teammates. Hou Siqu, a member of the unruly undergraduate cohort, offered an example of the feeling of interdependence of teammates when the team clicks:

I have experienced [*moqi*] before, for example at the National Championships in Yantai in 2015, or the final tournament this year in Qingdao. I felt that there was a particularly good team atmosphere, we were really united. For example, if I can't make the tackle, you come in and help me make it up, if you can't make the tackle, I go and help you make it.

有过，比如说在烟台站的全国锦标赛和最后一站青岛锦标赛，我感觉气氛特别好，特别团结。比如说我防不住的你来帮我补，你防不住我去帮你补。

As explained in the previous chapter, the recognition of interdependence between teammates was an important facet of athlete experience of being a member of the rugby team at the Institute. Hou Siqu explains that *moqi* involves not only the recognition of interdependence, but also the perception of *reliability* of interdependence—a level of trust or confidence in others to perform their roles in collective performance.

Consistent in all of these descriptions of *moqi* reported here are dimensions of viscerality and agency. First, perceptions of *moqi* are grounded in feelings and sensations, as opposed to more propositional or formulaic declarations of how on-field coordination is achieved. Second, athletes distribute agency for team click throughout categories of the self, others, and the group. Together, this evidence substantiates the claim advanced in this thesis that team click entails two core dimensions, one involving visceral perceptions, and the other involving perceptions of (social) agency.

5.2.2 Social bonding is identified as an important precedent and antecedent to team click

As foreshadowed above in various excerpts, athletes associated the concept of *moqi* with qualities characteristic of social bonding, such as perceived emotional support, perception of unity or common goal, and social identity. In some instances athletes proposed these characteristics as necessary precedents to team click, while at other times they were suggested as antecedents. Below I present representative excerpts from interview data.

Undergrad Ming Xiaokai suggested to me that off-field social interaction was important for generating *moqi*:

MXK: Tacit understanding is definitely there, but its relatively rare. But when you're up against it you feel very united, especially when sometimes in a match you take the lead again [after trailing the opposition team].

JT: What do you think is the source of this feeling? How do you achieve this sort of outcome?

MXK: It doesn't matter if its on-field things do do with training, or off field things, like more interaction off the field, more communication, when its a bit of fun, when we're all relatively good friends, you know? When its like this, I feel like I want to try a bit harder, share more things with others, that type of feeling. If my teammate gets tackled I'll get really angry and want to help them. It's friendship: the feeling of playing alongside really good friends, good mates, scoring a try together, winning by one score after the scores are level all game, its especially, especially joyous, very exciting. That's it really, when things are really tough, and when we all come in and put our hands on the ball, I'm really happy.¹

MXK: 默契肯定是有, 但是比较少, 但是打逆风球的时候会特别团结, 有时候会反超.

JT: 你觉得这个感觉的来源是什么? 如何才能得到这种效果?

MXK: 不光是训练场上的东西, 场下的东西, 场下的一些交流, 一些沟通, 比较好玩, 比较好朋友吧, 我感觉天天场上做的时候感觉想多努力一分, 多分享一些东西, 这种感觉。他们要是被扑搂了, 也会很有气儿, 会想去帮助他们。

¹Xiaokai was referring to a common pre-match ritual adopted by rugby teams over the world, where a team will crowd around each other in a huddle, and each player places a hand on a rugby ball before chanting together something like "let's go" (*jiayou* 加油), as is generally the case in China.

友情。和特别特别好的朋友，特别特别好的哥们儿，一起打球的感觉，一起达阵，平分赢一个球一起赢的那种激动，特别特别开心，很激动。主要就这些，特别困难的时候，打发成球，特别开心。

Xiaokai emphasised the role of off-field interaction, communication, and, in particular, friendship in producing *moqi* on the field. Senior athlete Lu Zhongsheng's (a.k.a. "Big Mouth Monkey", hereafter Big Mouth Lu) testimony echoed the perception that emotional affinity and social connection associated with friendship was an important precedent to team click. Big Mouth Lu was a gregarious senior athlete who was very talkative in our interview, and his explanation was accordingly elaborate:

First of all, you must have a common direction and goal. For example, which team are we going to take down today—everyone has this "must win" conviction in their mind. Everyone works together; no abandoning each other and no giving up, most importantly when you're behind (in a match) you can't give up, there's still hope, as long as the time is not up there is still hope. We shoulder the pressure and are determined to prove ourselves. It's the presence of that real feeling that "all for one and one for all." And then that feeling of everyone crying together at the end of the game is great! Because we've endured such agony...

首先是大家有一个共同的方向和目标，比如说我们今天要把哪个队拿下，大家每个人的脑子都有这个必胜的决心，大家一起努力，不抛弃不放弃，最重要的是及时落后了也不能放弃，我们还有希望，时间还没到我们就还有希望。背负压力，我们一定要做好，就像我们要证明自己。真正的在场上每个人都做到那种“人人为我我为人人”的感觉，然后比完赛大家都一起哭了那种感觉特别棒！很痛苦我们都吃的...

Junior athlete Meng Cheng also offered a very emotive response to the question of antecedents to team click:

If we want to play, we do it together, and usually there's nothing we can't say to each other. For example every week a few of us all drink and eat a bit and have a chat. I think this is very important, because if you have a drink and a meal and talk a bit of shit you feel relatively...you generate that *feeling* you know? Like when you're drinking together and you feel particularly intimate, really close. Besides that, then its also when you're doing fitness and can't keep up, and the coach is going to punish you, and so whoever can't go on you give him a hand and pull him along. Everyone has the same goal and is motivated.

大家要玩一起玩，平时无话不说。比如每周咱们几个大家喝点（酒）吃点聊聊天。我感觉这个很重要，因为你喝点吃点吹点牛感觉是比较。。。你来这个感觉吗？比如说喝的时候感觉特别亲密，特别亲。剩下就是体能训练的时候跟不上教练要罚的时候一起挨罚，谁跑不动了就拉一把。大家目标一致，都有上进心。

Despite asking explicitly about the sources of *on-field* instances of *moqi* many athletes quickly and automatically departed from on-field joint action to off-field social processes of affiliation, including perceptions of emotional support or intimacy and perceptions of common goal between co-actors. While athletes occasionally cited more specific antecedents to click such as better communication and more time spent together, it was telling that a large portion of athletes gravitated immediately to more feeling-based explanations.

Social inferences associated with team click also included personal characteristics and social virtues. Timid junior athlete Yang Can, for example, suggested that *moqi* requires heart-felt commitment:

YC: I have [felt *moqi*] before, when I was playing in that National Tournament, in that game against Liaoning Province. Everyone was giving it their all.

JT: Where do you think this type of feeling comes from?

YC: It comes from the heart. No matter what, you can't let the opposition score a try, somehow you must shut them down in defence, and don't let them run.

YC: 有过，在打那个全国比赛的时候。打辽宁那一场，所有人都在拼。

JT: 你觉得这种很拼的感觉来源在哪？

YC: 发自内心的，无论如何不能让对手达阵，怎么样也得死防，一定要防住，不让他们跑。

Here, Yang Can emphasises that team click requires of athletes a certain kind of personal or mental attitude—one of determination. Senior athlete and coach Lu Peng also proposed a certain type of attribute required for team click. Always quick to problematise the athletes below him, Lu explained why he thought that the current Beijing team lacked *moqi*. When I asked him if there was any click in the team currently, he replied:

No, its very rare. Not like it was with us before [before 2013], because when we were like that... when we'd go out to compete we'd work hard. Now they [the more junior Beijing athletes] wouldn't come and find senior athletes to discuss these sorts of things. They're thinking about their own little things every day. They wouldn't even think about doing it, let alone actually doing it. They skimp their way through training.

It is very important thing for athletes to be— my former coach used to say this word...I don't know how to say it in English. In China we'd say this athlete has a strong "animal intelligence." Ok, I'll try to explain it to you: animal intelligence is talking about, well first: we are all primates, right? And primates are really smart! So this so called animal intelligence, in the case of rugby, is that on the field you have incredible creativity: you can do things that others don't expect. This is the idea of animal intelligence in an athlete. And you can do it often, inconceivable things, when you're extremely intelligent on the field. This is animal intelligence.

没有，很少。不会像以前我们那样。因为我们那样的时候...前后我们出去主要是努力。现在他们不会去跟老的聊这些。天天在想自己的小事情。他不会去想，而且也不会去做。训练的时候敷衍了事。球员很重要一点就是，教练曾经说过一句话，我不知道英文怎么讲，在中国中文讲是这个球员很有灵性！...我试一下给你解释啊：灵性就是说，咱们单人都是灵长动物是吧？就是特别聪明的！就是所谓的灵性就是对橄榄球的话就是，在场上你有很好的创造力：别人想不到的你能做出来，就是灵性。经常能做出来。想不到的东西，特别聪明，特别灵性。

I went on to probe as to why younger athletes did not display this mysterious "animal intelligence" (a term for which I could not retrieve a fluent English translation) in rugby:

JT: Why do you think the young athletes don't have this intelligence?

LP: Its a problem with the environment they're in, there is no competitiveness, no motivation. At that time we were very competitive and so we were motivated.

JT: 那你觉得年轻队员不做这个是因为...?

LP: 环境问题嘛、没有竞争力，没有动力。我们那时候就是很有竞争力，有动力。

Lu's exegesis of the sources of team click was brimming with nostalgia for a former era of the Beijing team. In this imagined previous era, athletes developed a level

of mastery on the field due to an environment in which athletes were competing viciously with each other for a spot in the team. Without the same level of motivation, the current squad of athletes did not develop that mysterious quality of animal intelligence. Here, animal intelligence offers Lu a vehicle through which to explain the sources of optimal performance and justify its current lack in the Beijing Team.

In addition to personal qualities of motivation, hard-work, and conscientiousness, environmental explanations were also given for team click in joint action. When I asked him about the reason for a lack of on-field click in joint action in the Beijing team, senior athlete Ma Haitao utilised a combination of personal and cultural (environmental) explanation to account for the team's issues with on-field performance. In this instance, he generalised between China and the West:

MHT: Chinese people's conscientiousness is very poor.

JT: Why do you think that is the case, really? What is the reason?

MHT: Environmental factors, environmental influence. Like you all (Westerners) from a young age in your environment, you things have to be done a certain way [according to some form of virtue or norm]. Our environment isn't like that. First, (in a group situation) you (as a Westerner) will think "we are all teammates," and your team all think that this principle is very important. But we all think "it doesn't matter, I can just go with the flow and that's enough." But you are not like that, you are like "this is just how it must be done." Just like what we were talking about in the gym, about your personal "disposition": you said you need to get up in the morning and feel like you're being productive... China also has its own kind of disposition, which is always "have a look first" [before committing to anything]...

MHT: 我们中国人自觉性很差.

JT: 为什么? 到底? 原因在哪?

MHT: 环境因素, 环境影响。像你们, 从小你们环境影响觉得就该是这样。我们环境影响不是这样。一是认为“你们是队友”, 你们队都觉得这个很重要! 但是我们觉得“无所谓, 我变通一下就可以了”。但是你们就不是, 你们是“他就应该是这样了”就像我们在健身房聊天说那个“形势”, 早上起来要干啥, 中国也有一口, 他就是总的形势是“看一下”...

Problematising Chinese culture, by contrasting it with a valorisation of “Western” alternatives, is a common trope in contemporary Chinese social discourse, with strong historical roots (Liu, 1995). Much like Lu's use of animal intelligence,

Ma's appeal to cultural variation (in this case between China and the West) as an explanation for performance outcomes in joint action serves as a convenient vehicle or affordance to account for what are, in reality, complex mechanisms and coordination dynamics in joint action to which athletes have very little direct perceptual access.

Senior athlete Pan Qiyu also critiqued the Chinese sport "system" (*tizhi* 体制), drawing attention to the fact that the Chinese competitive sport system has proven unable to foster effective on-field coordination in team sport:

Take Chinese football. If you're talking about competitive sport system in China, the Chinese football team can barely beat a random student team. Its a complete mess! There's no thinking in the competitive sport system, nothing in the brain, no "innovation" (to use a foreign way of speaking). Basically, there is no will to build emotional connection, coordination, or tacit understanding between teammates, and so it leads to this type of feeling at the moment [with team sport in China]. So that's why I think that basketball, football, rugby must all develop as school sports, like they did in America, Japan, and also Europe. They all developed their sports in schools. From a young age, [students] first develop interpersonal skills of communication and team awareness, and I think this is really great. The Chinese sport system is missing this.

我觉得这个中国足球，竞技体育，连个学生把子都踢不过，天天战乱！，所以竞技体育，人的脑袋没有东西，没有创造力（就是用外国的说法），队员之前没有感情，没有配合，没有默契的意志，导致这种感觉。所以我还是觉得什么篮球，足球，橄榄球必须走校园体育开展。应该像美国日本包括欧洲，都是在校园开始开展，从小开展，一是培养人与人之间的沟通和团队意识，我觉得这个比较好。中国体育体制就却这个

When I then went on to ask Pan about the feeling of tacit understanding and team click, he naturally drew upon his critique of what was lacking in the Chinese sports system to describe what is important to optimal coordination:

PQY: I have experienced the feeling of tacit understanding, yes. I've had harmonious times and unharmonious times. When I was in Dandong (Liaoning Province) that team was relatively harmonious. The seven of us on the field I felt were pretty unified, I felt that that kind of atmosphere was really good.

JT: What do you think is the source of that feeling?

PQY: Every individual is inclusive and positive, and accommodating of each other. Every individual has weaknesses, but then everyone is accommodating of the weaknesses on the field, I feel that its better like that, its more motivating, it makes people...

PQY:有过，有过和谐的时候也有不和谐的时候，我在丹东的时候那支团队比较和谐，我们场上的那七个人我感觉是比较团结，感觉那种氛围感觉比较好

JT: 你觉得这种感觉的来源是什么？

PQY: 每个人很包容和积极，大家都互相包容。每个人都有缺点，但是每个人都包容每个人的缺点在场上，我感觉这个比较好，比较动力，比较能让人。。。。

Pan trailed off his final sentence, unable to properly capture his final thought. Like many other athletes, Pan communicated a strong conviction about the existence of team click, but couldn't quite put his finger on the precise feeling or casual mechanics of the phenomenon.

In sum, these excerpts suggest that athletes draw on a number of associated concepts in an attempt to articulate team click. Many of these these concepts are social in character, pertaining either to the level of the team (team unity, cohesion, common goal), the individual (virtues of commitment or capacities such as animal intelligence), or to broader institutional (e.g., Chinese sport) or cultural (East vs West) systems. Notably, athletes would tend to automatically depart from on-field coordination and talk instead about off-field social processes and dynamics. These results suggest a possible association between team click and social bonding, whereby the visceral and socially agentic sensations of team click are connected to more elaborate cultural affordances characteristic of group membership (H1b).

In the following section, I ask how athletes experience joint action in rugby, in order to shed more light on the cognitive mechanisms hypothesised to generate the phenomenon.

5.3 How do athletes experience joint action in rugby?

In this section, I assess evidence for the theoretical claims pertaining to mechanistic underpinnings of a general account of team click in group exercise, specifically:

1) responses to uncertainty in joint action, and 2) positive expectation violation concerning team performance as two interrelated predictors of team click and social bonding in group exercise (H2).

In Chapter 4, I reported findings that athletes experienced joint action scenarios defined by higher levels of uncertainty as more difficult or challenging. Here, I analyse evidence for how athletes respond to uncertainty in joint action. In particular, I find evidence that joint action is the source of negative experiences such as performance-related anxiety and pressure. While athletes also appear to experience pressure associated with on-field performance, it appears that more senior athletes developed certain on-field strategies in order to mitigate the costs and uncertainties of rugby's joint action.

Results also suggest that athletes performance-related pressure and anxiety contains a strong social dimension, and is usually expressed in relation to the threat of scrutiny from the coach or more senior players. Athletes report strong feelings of “social guilt” (*neijiu* 内疚) associated with perceived shortcomings in on-field performance. Again, it appears that more senior athletes were able to deploy more nuanced discursive strategies in order to deflect responsibility for poor team performance away from themselves. Opportunities for strategy and deflection appear to be less available to junior athletes who, by contrast, tend to admit personal shortcomings and personal responsibility for poor on-field performance. These observations are supported by findings from an informal survey study, which was designed to interrogate both the role of variation in uncertainty and variation in seniority on perceptions of joint action.

In addition to these findings concerning the stress of rugby's joint action and the various coping behaviours that appear to mitigate it, I also find evidence to suggest that athletes experience better-than-expected performance as positive, enjoyable, and exhilarating. Taken together, these results confirm the validity of the secondary hypothesis of this thesis (H2), and motivate further empirical investigation into the role of uncertainty and expectation violation in generating perceptions of team click.

5.3.0.1 Technical challenge of joint action is associated with social pressure and anxiety

Athlete testimonies during interviews make clear that that the challenge of joint action in rugby gives rise to social and emotional pressure.

Performance-related pressure and anxiety

Many newcomers who transition from individual sports to rugby have very little background in interactional team sports. As such, athletes are unfamiliar not only with the specific joint action demands of rugby, but also the norms of group membership associated with the rugby team (see Chapter 4.4.2.2). Young trialist Lian Jianxiang had spent most of his short amount of time at the Institute on the sidelines nursing a series of recurring shoulder injuries. In an interview Jianxiang explained his performance-related anxiety to me:

The pre-set moves, when playing a game and you're doing a move (in attack), or coordinating, and you don't know what the situation is; sometimes someone will break the line and then I know what do... I feel a lot of pressure. When I first started and even now, there was once, right before a Tournament, we were training at high intensity and Coach Zhu, he would say something, and as soon as I'm tired I can't process it, that feeling that "I know what I am supposed to do, but I can't actually do it."

战术、打比赛的时候打一些战术，打配合，不知道咋办的情况，有时候一个人出了突发状况就不知道怎么办了。感觉压力很大。刚练的时候，现在也是，有一段时间，快打比赛前强度特别大然后朱导，有时候（教练）说什么一累就都听不进去，知道该干啥但是做不出来的那种感觉。

Jianxing's explanation touches on the combination of pressures that coalesce in joint action in rugby. Not only do athletes need to somehow anticipate, monitor, and adapt to unfolding in-the-moment joint action, but they must also incorporate instructions arriving from sources external to the immediate joint action. As explained in the previous chapter, the coach and senior athletes were usually the source of this higher level instruction and directing of joint action (see Chapter 4.4.2.1). Through long-term observation of (and participation in) training,

I often witnessed the stress and anxiety experienced by more junior players, usually due to the scrutiny of the head coach or more senior players (see Chapter 4.4.2.1).

Ming Xiaokai, one of the unruly undergrads was very honest to be about the pressure he feels when training and playing:

MXK: My most unwanted thing is too much pressure, pressure is the most difficult thing, in a match or in training if I am under pressure. If I am under any pressure I feel I won't perform well.

JT: The pressure you feel, where does it come from?

MXK: Obviously it's the pressure you feel from the coach, pressure from your opponents is one type of pressure, but I am able to use that as a motivation. But if for example the coach gives you added pressure, if the coach gives you a requirement, and you need to do it on the field, the more you think about it the easier it becomes to make mistakes. I feel like the pressure from the Coach is relatively big.

MXK: 我最不愿意是有太大压力，压力是最困难的，比赛的时候或者是训练的时候有压力的话。我有压力的话我感觉会发挥不好 JT: 感觉到的压力是从哪来的？ MXK: 教练肯定来的一部分，对手的压力是一种比较好的压力，我会把它当作动力。但是如果教练给你曾加压力的话，教练给你要求，你要在场上，你老想到越来越来离大越容易犯失误。教练的压力我感觉比较大。

Here, Xiaokai and Jianxiang's experiences suggest that for some athletes, the external pressure felt from the coach can be enough to hinder performance.

The threat of scrutiny from the coach appeared to be a significant source of athletes' stress relating to on-field performance. Senior athlete Lu Peng reminisced about his potent experiences of video analysis session with Zheng Hongjun:

...especially when we were analysing video: we'd spend three hours analysing a seven-minute video...So much detail: he'd analyse every little chicken feather and garlic peel [every triviality] for each of us. For example, if the ball was slippery and you didn't pass the ball properly in that play because the ball was slippery, it would become your personal issue....

尤其是我们看录像，7分钟的录像看三个小时。很细。鸡毛蒜皮都会给你分析到。你比如说我就是球滑没传好，这个小失误都会上升到你的问题...

I asked Lu why he thought Zheng was so strict and critical of athletes in these sessions. He replied:

It's due to belief and habit. Before it was extremely strict, we were all scared to bits, on whichever day, every detail of every video you would remember so clearly. 'The video is coming my way!' Shit, it was a whole serve of cursing with the blood of dogs, it would scare you to death, cursing like the blood of dogs, in front of all these people, the pressure was extremely high, normally people can't accept this atmosphere! Normal people can't come back from that!

信仰和习惯。以前就是非常严格，看录像我们都吓坏了，哪天你，每一个录像每一个细节我们都记的很清楚。'马上到我马上到我!'一顿狗血骂人，吓死你，骂得你狗血里面XX，当了那么多人的面 压力非常大，一般人在这个气氛下受不了。一般人出不来！

In many of these instances, the technical challenge of joint action appears to be experienced as stressful, usually due to the scrutiny (or threat of) from the coach or senior players.

Strategic management of costs associated with joint action

I observed evidence to suggest that athletes may have experienced the challenges associated with joint action differently based on their experience and familiarity with the sport. When I asked senior athlete Ma Haitao, for example, about how he approached joint action in a rugby match, he explained that he would strategically manage his levels of physiological exertion:

It depends on the situation. In a game, if the score is close then I will be one kind of mindset, if we are ahead then I will be of another mindset, if we're behind then I will be in yet another mindset. When the scores are close and we can come back or if we're in front by only a little bit then will persevere. But if we're in front by a lot then for the one minute remaining in the game, I'll start to think about the next game, and I won't persevere. Now, if the game has just started, no matter how tired I am I will of course persevere. If we're behind, no matter what time in the match it is, I will grit my teeth and persevere...I just want to win, its about just not losing, its that simple.

看情况吧，打比赛的时候，比分接近我是一种心态，我们领先是一种心态、落后时又是一种心态， 比分很近能追回来或者只领先一点点就会坚持。但是如果领先很多就只剩下一分钟，我会考虑到下一场，就不会坚持。那如果是刚开始再累我都会咬牙坚持的。如果落后不管什么时候我都会咬牙坚持..就是想赢，就是不能输，就那么简单。

Most senior athlete, Han Xiaolong, also explained how he had learnt to be strategic in managing the risks associated with injury in rugby, in order to prolong his playing career:

Because look at me, my leg has been injured for a while now. If this leg gets injured again I would definitely be quite worried [about my ability to continue playing]. In this type of situation, I will lower my own, say my own requirements: before I would set myself the goal of playing better than everyone else, stronger than everyone else, training harder than everyone else. But now I might choose to train in a way that will enable me to protect my body and guarantee that I can continue to play rugby. The young ones can “pa-pa-pa” [onomatopoeic description of the act of playing rugby] and do everything, give everything they have each day, and do it again the second day, and the third day, but now my body doesn’t allow it.

...因为你看，我现在腿受伤了一阵儿了，我如果这个腿再受伤的话我肯定特别害怕，在这种情况下，我会降低一些自己的，比如说对自己的要求：以前会要求自己打到要比所有人都好，比所有人都多强，比所有人练的都要刻苦。现在我可能选择为了保证自己的身体，保证自己还能继续打球的情况下去训练...年轻的可以吧吧吧什么都可以，一天付出所有的努力，第二天再来，第三天再来，但是现在不允许了身体

In contrast to junior athletes, many of whom were still in the process of familiarisation with the complex technical and social requirements of the sport, these passages suggest that more senior athletes had developed a more nuanced relationship with the on-field challenges of rugby. By contrast, when I asked Chao Yang student Wang Zhankun how he managed the physiological costs associated with rugby, he replied with one simple sentence: “I do my best and persevere” (尽自己最大的努力，坚持). Or, when I asked fellow young hopeful Jiangwei about what went through his mind during fitness sessions in training, he also responded simply and directly: “I persist. I have to hold on to keep up with the person in front of me anyway” (坚持，反正一定要把他顶下来). Of course, the fact that more senior athletes are able to explain in more granular detail their strategy towards rugby’s on-field demands communicates just as much about their social standing in the team as it does about their familiarity with rugby’s joint action requirements. More senior athletes were much more comfortable talking freely with me during interviews

and in informal conversations. Nonetheless, this stark contrast between older and younger players in relation to understanding the way in which they ought to engage with the on field requirements of rugby communicates information about the level of psychological stress that surrounds on-field performance, and the strategies that athletes have available to them to quell this anxiety.

5.3.0.2 Technical challenge of joint action is associated with social guilt and deflection of responsibility

Before I began performing semi-structured interviews, I had already sensed through my own observations and initial conversations with athletes and coaches that athletes—particularly junior athletes—experienced high levels of discomfort and pressure around on-field performance. When I asked coaches and athletes about this experience, the term *neijiu* (内疚) was often used to describe the sensation. *Neijiu* translates roughly to socially-derived guilt or shame (Pleco, 2018). The use of this term in particular suggested that anxiety around performance contained an important social dimension.

When I asked athletes in semi-structured interviews whether or not they experienced *neijiu* in the context of rugby, the responses were telling. Many athletes admitted that they would ruminate heavily on their perceived quality of individual performance in relation to expected standards of performance. Hou Siqu, one of the (not-so-unruly) undergrads from Heilongjiang Province, explained to me his experience of *neijiu*:

Yes, I have had the experience [of social guilt] (laughs), especially when I was first starting. After every mistake, or missed tackle. Because I am a forward, and my restart receipts were pretty weak, so I would make a lot of mistakes, and feel a lot of (social) [*neijiu*] guilt. I wasn't doing my job.

有（笑），尤其是刚开的时候，每次失误，或missed tackle，因为我打前锋 接开球比较弱，很多失误，很内疚。自己的工作没做好。

As young student athlete from Chaoyang School, Jiangwei, explains, the feeling of guilt is often associated with a process of rumination about personal experience in relation to internalised expectations:

Sometimes you don't do some things correctly, and you go back and reflect on it for ages. I really think about it for ages. sometimes when the coach calls me out I will reflect on it, I will think for a long time. Also when I myself think that I have not done it correctly, and then I will think about it a lot too.

有的时候有的地方自己做的不对回去就把自己老反思，老想，有时候教练说我我也会反思，想好久。还有我自己觉得我做的不对，然后都会想。

Senior athletes were more able to personally manage performance-related stress and social guilt associated with performance

Evidence suggested that, in addition to developing on-field strategies for coping with the challenges of rugby's joint action (such as conserving energy and avoiding injury), more senior athletes also developed more elaborate social strategies for dealing with performance-related pressure and social guilt. I commonly observed evidence of more senior athletes deflecting (either deliberately or unwittingly) responsibility for poor on-field performance to more junior athletes.

Rather than admitting to personal feelings of social guilt, rumination, or remorse, senior athletes would instead draw attention to the role of junior athletes, or alternatively the role of enduring cultural intuitions in impinging upon the quality of team performance. When I asked senior athlete Ma Haitao about his understanding of team roles, for example, he launched into an animated critique of the attitude of junior athletes:

MHT: Often when we're in the dormitory when I can't put up with their behaviour I tell them its like this or its like that...but the junior athletes very rarely come and find us for advice, very few are actively motivated to study themselves. Its always us [senior athletes] who are telling them what to do...always on the field calling them out, they rarely come and talk to us personally. But I am not like that, I used to love finding senior athletes, and I also like watching footage of rugby games, replaying each bit of the game.

JT: Now as a senior athlete, do you feel a responsibility towards the junior athletes?

MHT: Yes, I really want them to improve, work with them for mutual benefit. But the spirit for mischief in this group (of junior athletes) is so strong! In China—I don't know if you guys from overseas are like

this—but in China all they want to do is play games, they don't take the initiative to learn. Rarely do they grab a computer and watch some [rugby] footage...I don't know how they understand [the situation].

My understanding is, if I don't have anything else to then I'll watch some rugby footage. I rely on my conscientiousness. I am quite a classic example of a conscientious athlete here. Chubs though [referring to his roommate Yang Can]! His phone has rugby footage on it, there are games on there, and movies, but unless I insist that he watches it he doesn't watch any of the rugby footage, rarely do they watch any rugby footage. They are not conscientiousness at all. We Chinese, our conscientiousness compared to you folk, our conscientiousness is pretty bad, even my awareness is bad actually.

MHT: 在我屋里我经常跟小师弟说，看不惯他们就会告诉他们该这样该那样...小的找老的很少，自己主动的去学习很少。都是我们跟他们说...都是在场上我们说他们，私下里他们找我们很少。我就不那样，我就爱找（老队员），我还喜欢自己看录像，一遍一遍回放。

JT: 作为老队员，有对年轻队员的责任感？

MHT: 对，特别想他让他们提高。互利的，互助。但是这批小孩玩心太大。中国——我不知道你们国外的——他们就爱玩游戏，不会主动学习。很少抱着电脑看比赛录像...我不知道他们怎么理解。我的理解就是，我自己没事还会看录像呢。就是凭自觉。就像我自己我就是典型的一个。胖子！他手机里有比赛录像，有游戏录像，有电影，他们不看比赛录像很少看。没有自觉性。我们中国人的自觉性跟你们的话，我们自觉性都很差，我自觉性也很差。

Here, Ma first props up his roommate Chubs (Jianxiang) as a representative of all junior athletes, and in so doing is able to highlight his own conscientiousness. Then, Ma employs a similarly structured strategy by proposing a binary between China and the West: Westerners—for whom I was a representative—are conscientious and diligent; Chinese people are less so, and prefer instead to go with the flow (see Section 5.2.2). Through both of these strategies Ma is able to deftly “explain-away” (to use the language of the AIF) the problem of poor team performance, and any part he may play in contributing to it.

After I had spent a few weeks at the Institute eating meals and talking largely to the senior athletes, it became clear to me that it was common practice for senior athletes to criticise the lack of motivation and commitment of the more junior athletes, particularly the unruly undergraduates who had just started university at BSU. Senior athletes drew attention to junior athletes and their vices of computer

games and girlfriends. Originally, I took the senior athletes on their word, and naively assumed that, in contrast to the these unruly undergrads, senior athletes embodied diligence and conscientiousness in their approach to rugby. When I soon discovered that this distinction was not universally the case (i.e., that senior athletes, like junior athletes, also spent considerable time playing computer games, staying out late, and missing meals), that senior athletes were using junior athletes as scapegoats for the stresses related to adherence to rugby at the Institute appeared to be a more likely possibility. Senior athletes' fixation on the role of junior athletes deflected attention away from the role of senior athletes in collective performance.

Considered together, these results suggest that the pressure of performance is a deeply social phenomenon, entailing experiences of social guilt as well as deflection of responsibility for performance away from the self and towards others. The pattern of within-group variation in responses presented here suggest that differing strategies for mitigating the uncertainty of performance may be associated with seniority.

5.3.1 Post-training surveys

Results of a series of informal surveys administered following three separate training sessions provided some additional evidence to support a suggested relationship between 1) levels of uncertainty in joint action and levels of performance-related stress and anxiety, as well as 2) variation in technical competence and variation in perceptions of on-field challenges associated with rugby's joint action.

Method

I administered a nine-item Flow State scale (Jackson & Eklund, 2002) after three separate training sessions. In the first training session, athletes participated in a common fitness test known as the "Beep Test." The Beep Test is designed to measure maximal aerobic fitness, and requires participants to run a series of 22-metre shuttles for approximately 20-30 minutes, depending on how long each athlete survives in the test (see Stickland, Petersen, & Bouffard, 2003). The Beep Test involves no direct joint action demands or interaction between athletes. Athletes

did, however, run the test at the same time, side-by-side (as per convention), and so some incidental interaction may have taken place. The Beep Test training session (hereafter simply “Beep Test”) lasted approximately 70 minutes, including pre-test warm up and post-test warm down.

The remaining two training sessions simulated high-intensity match conditions. In both of these sessions, the training squad was split into two sub-teams, a first team and a second team, according to ability determined by the head coach. These teams then competed in a series of practice matches that simulated match intensity and conditions, but were not “full-contact” (instead, when defending athletes were required to “grab hold” (*zhuazhu* 抓住) of attackers rather than completely tackling them). Each match simulation training session (hereafter simply “Game Play 1” and “Game Play 2”) lasted approximately 90 minutes in total, including warm up and warm down.

After each of these sessions, I administered to each participating athlete via WeChat nine items selected from a validated Chinese version (Liu et al., 2012) of the Flow State Scale-2 (Jackson & Eklund, 2002). The items were selected to measure each of the nine conceptual dimensions of the flow experience: challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, total concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience (Csikszentmihalyi, 1990). In particular, two items relating to performance “Just now I did not care how others would evaluate me” (刚刚我不关心别人可能会如何评价自己) and “Just now I did not care how I performed” (刚刚我不关心自己的表现如何) were identified as indicators of athlete perceptions of performance, and were subject to individual analysis. All survey items used a 7-point Likert scale. Responses were collected within one hour of activity completion, with the aim of gathering the data as close to the finish of an activity as possible, while minimising intrusion on the participants (Jackson & Eklund, 2004). For full details concerning the survey, see Appendix C.2.3.

This study was thus designed so that the same survey items were administered after two qualitatively different types of training sessions, one involving high

physiological exertion and low uncertainty in joint action (The Beep Test), and the other involving both high physiological exertion and high uncertainty in joint action (Game Play). This design was administered serendipitously when the appropriate opportunity to contrast uncertainty in joint action arose. The joint action requirements of the Beep Test session were almost negligible, whereas the joint action requirements of the Game Play sessions closely resembled a real rugby match, except for the dimension of full-body contact. The contrast between these two types of training sessions provided the opportunity to compare athlete experience of varying levels of joint action complexity.

Results

12 athletes participated in the survey administered following the Beep Test ($age = 20.92, SD = 3.64$). Eight athletes were junior athletes or on trial ($age = 18.63, SD = 2.13$), and the remaining four athletes were senior athletes ($age = 24.6, SD = 2.07$). Many senior athletes did not participate in the test due to injury and required attendance at BSU lectures. 16 athletes participated in the survey administered following Game Play 1 ($age = 21.81, SD = 3.25$), eight of which were senior athletes ($age = 24.38, SD = 1.69$), and eight of which were junior athletes ($age = 19.25, SD = 2.19$). 16 athletes participated in the survey administered following Game Play 2 ($age = 21.81, SD = 3.25$), 8 of which were senior athletes ($age = 24.38, SD = 1.69$), 8 of which were junior ($age = 19.25, SD = 2.19$).

Results of interest for the post-Training surveys are reported in Table 5.1. Results showed very little overall variation in average flow scores across training sessions or according to the groupings of junior and senior athletes. When Flow Scores were analysed according to athlete training age, results appeared to reveal a visual trend (see Figure 5.1), but correlations between training age and Game Play 1 (two-sample $t(14) = 1.60, p = 0.14$) and Game Play 2 (two-sample $t(14) = .91, df = 13, p - value = .38$) were not significant.

Analysis of responses to individual items of the Flow state scale, “Just now I did not care how others would evaluate me” (Evaluation From Others) and

Survey Item	Beep Test (n = 12)	Game Play 1 (n = 16)	Game Play 2 (n = 16)
Flow average			
Overall	5.24 (0.65)	4.96 (0.57)	5.3 (0.88)
Junior	5.31 (0.74)	4.83 (0.42)	5.25 (0.84)
Senior	5.11 (0.48)	5.11 (7.16)	5.33 (0.97)
Evaluation From Others			
Overall	5.25 (1.35)	3.15 (1.95)	3.67 (2.19)
Junior	5.08 (1.04)	2.71 (1.97)	3 (2.24)
Senior	5.6 (1.98)	3.66 (1.97)	4.25 (2.12)
Self Performance			
Overall	4.32 (1.74)	1.92 (1.32)	2.93 (2.22)
Junior	4.2 (1.5)	1.29 (0.49)	2.71 (2.21)
Senior	4.55 (2.39)	2.67 (1.63)	3.13 (2.22)

Table 5.1: Key results from informal surveys administered following three training sessions (Beep Test, Game Play 1, Game Play 2). Table reports means with standard deviations in parentheses.

“Just now I did not care how I performed” (Self Performance), revealed variation according to training session type. In a comparison between the Beep Test and Game Play 1, the mean value for Evaluation From Others was higher in the Beep Test ($M = 5.25, SD = 1.35$) than in the Game Play 1 ($M = 3.15, SD = 1.95$) session, ($t(19.94) = 2.77, p = 0.01$). The mean value for Self Performance was also higher in the Beep Test ($M = 4.32, SD = 1.74$) than in the Game Play 1 ($M = 1.92, SD = 1.32$) session, ($t(15.06) = 6.06, p < 0.001$).

In a comparison between the Beep Test and Game Play 2, the mean value for Evaluation From Others was higher in the Beep Test ($M = 5.25, SD = 1.35$) than in the Game Play 2 ($M = 3.67, SD = 2.19$) session, (two-sample $t(21.84) = 2.00, p = .05$). The mean value for Self Performance was also higher in the Beep Test ($M = 4.32, SD = 1.74$) than in the Game Play 2 ($M = 2.93, SD = 2.22$) session, (two-sample $t(15.06) = 6.06, p < .001$). Mean scores of these two items appeared to differ according to junior and senior athlete for both Game Play sessions, but no differences were significant (all $p's > .29$).

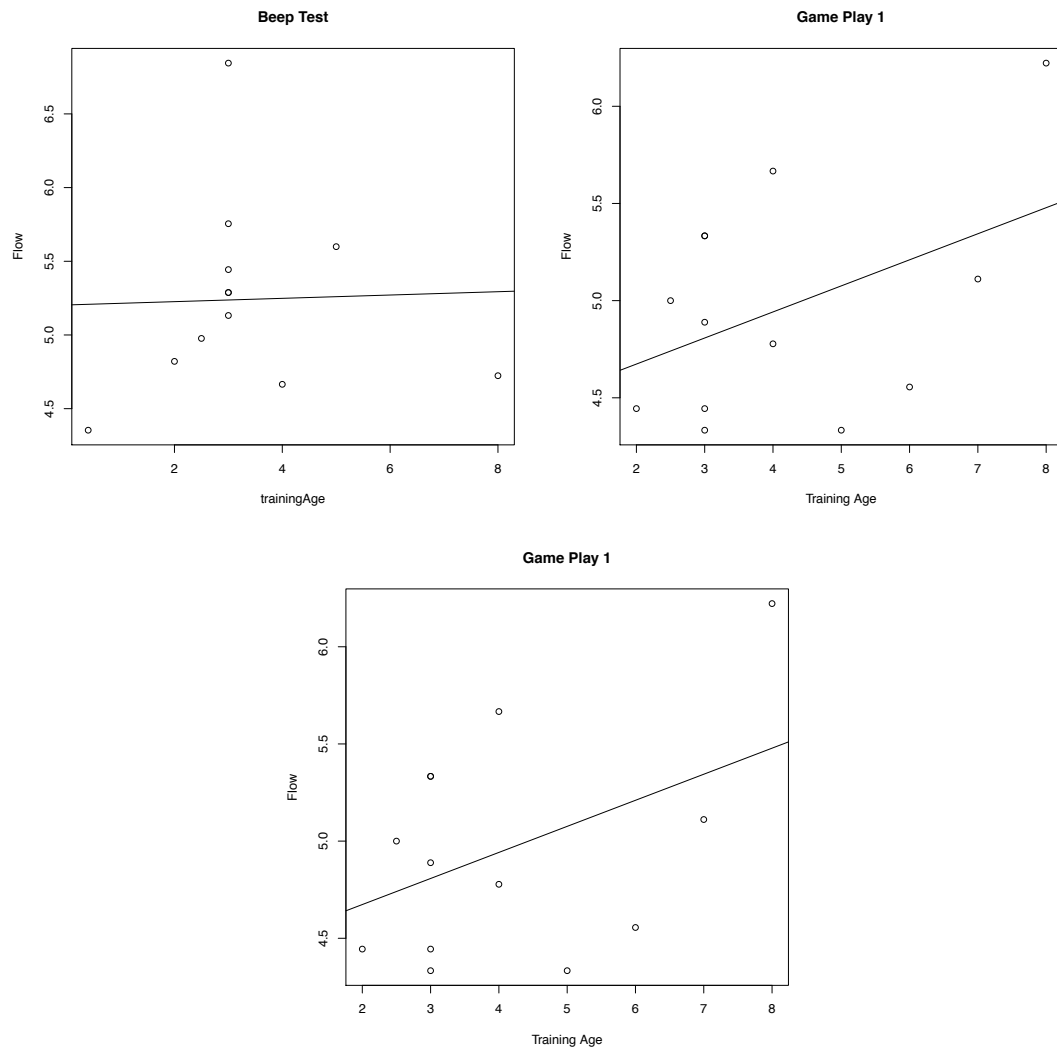


Figure 5.1: Flow State by Training Age in three training sessions (Beep Test, Match Sim 1, Match Sim 2)

Discussion of results

This survey study was conducted opportunistically and without necessary randomisation or control required for causal inference. Results do, however, offer some reinforcement of other sources of ethnographic evidence. First, results revealed a difference in experience of performance-related concerns between the Beep Test and the Game Play sessions, suggesting that the level of uncertainty in joint action could be one possible factor (among others) contributing to this observed difference. Further investigation of this possibility would require a controlled experimental design in which uncertainty in joint action was systematically varied or controlled

(see Chapter 7). Second, results suggest a possible association between athlete training age and reports of Flow, such that athletes more experienced with rugby's joint action demands on average experienced higher levels of flow in the Game Play sessions than athletes less experienced with joint action in rugby.

5.3.2 Athletes experience positive violations of expectations concerning performance

The evidence presented thus far emphasises on-field performance as a source of psychological stress for athletes. At the same time, I also documented evidence that athletes derived considerable joy and motivation from successful performance. The vignette in which I describe Hongwei's journey from timid novice to exhilarated junior team member serves as an emblematic example of this phenomenon (Chapter 2.1). In this section, I present more evidence that bears upon the hypothesis that more positive violations concerning team performance will generate higher levels of team click and, in turn, higher levels of social bonding (H2b).

In addition to Hongwei, I noticed many other athletes gradually develop—and at times impressively deploy—a tacit “feel for the game” on the training field and in competition. My discussions with athletes in interviews confirmed the fact that athletes derived considerable motivation from the experience of discovering that they were suddenly capable of performing one aspect of rugby's diverse technical skill set. Athletes recount with unmistakable energy and elation the moment in which their previously held expectations around individual and team performance were *positively* violated.

Wang Zhengfeng offered one powerful example of athlete experience of positive violation of expectations around performance in rugby. Wang Zhengfeng was a very talented, but still inexperienced, athlete, who had converted from athletics to rugby in 2012. He was an athlete with outstanding physical attributes for rugby—particularly speed, agility, and strength. Wang struggled, however, to master some of the basics of rugby's game play, such as catching, passing, and tackling. I asked Wang about his approach to the challenge of learning the skills of rugby from

scratch, and he recounted the time he first discovered that he could execute a “side step” (a technique used by the ball carrier to evade oncoming defence):

JT: How do you overcome this challenge [of learning new skills in rugby]? Do you have a specific plan or way of approaching it?

WZF: I imitate. Like when I was learning how to sidestep. At the time I'd look at Brother Han [Han Xiaolong] who has a really good sidestep. I'd just watch him stepping. Every day I'd just watch him step, and imitate him. At the start I probably wasn't practicing it particularly well, I couldn't quite imitate it, but then after some time, I was playing touch and suddenly produced the exact action! I was so happy! Its not like it appeared at a fixed time or anything, it was like suddenly I just moved a step and it happened. And then, like after I stepped once, I slowly found the feeling, and then stepping became my own thing. When you pick up new skills for the first time it feels very addictive, I get so happy, when it happens I can stay happy for a long time!

JT: 那你自己通过什么样的方式克服这个困难，你有计划和想法吗？

WZF:模仿。就像变相一样，我当时看龙哥做的特别好，我就看他们变向，天天就看哎，模仿一下，可能开始练得不是特别好，模仿不大会，但是时间长了以后，打TOUCH的时候突然做出了这么一个动作！就特开心！对没有固定的时间出来的，突然动了一步就出来的。比如变向突然出来之后，慢慢就找到感觉了，变相就变成自己的东西了。做出来新的动作以后就觉得很过瘾，特别开心，能开心很长时间了！

Over time, I learned that Wang was an athlete who experienced a lot of performance-related anxiety. Given his physical attributes and his obvious potential to be an effective rugby player (he was, for example, one of the fastest professional rugby players in China), he and the people around him (coaches and other senior athletes) held high expectations for his performance. Often Wang felt like he didn't live up to these expectations. When Wang did experience the feeling of perceived success in joint action, however, he felt elation that could last for “a long time” afterwards. Importantly, Wang's description above indicates that the unexpected nature of the side-step was an important dimension to its emotional valence.

The young hopeful athlete Yang Can, a junior athlete who also had impressive physical attributes for rugby, but was incredibly timid, gave a more low key response to a similar discussion in our interview:

When I first started practicing, ok, I'll just carry the ball forward and hit it up [that was all I could do]. After that, I discovered that there are many techniques: you can fend people, you can step, you can run into a gap. There are many other actions (than just running straight towards the defence with the ball).

刚开始练得时候就是拿着球往前跑，撞呗，后来发现有好多技巧，也可以推人，也可以变向，也可以走空档，有很多其他动作

While the words on the page perhaps do not quite jump out in the same way that Wang's description does, Yang Can's description of his discovery of rugby's many techniques was a bright and animated spark in an otherwise reserved interview, in which many of his responses rarely involved more than a few sentences (and often only a few words per sentence!). His joy in describing the sensation of discovering new dimensions to his technical repertoire was clear.

These two examples relate more closely to the category of individual performance. I also found evidence that positive expectation violation applied to team performance. As senior player Han explained, he only began to really enjoy rugby when he had an opportunity to coordinate with others:

When I first started training for rugby, when I first started getting exposed to contact I was a little bit afraid, but then after I have been exposed for a longer time I became less and less afraid of contact, and then I felt more and more that as I added a few more things...like when I started to find that coordination between players when playing touch...Because I really enjoy that sort of "two people coordinating—" "pa-pa-pa" [describing the action of coordinating movement and passes on the field in rugby] passing between players and breaking through the line" type of feeling, I really enjoy it.

刚开始练橄榄球的时候，刚接触对抗的时候有点害怕，但是接触的时间长了以后就越来越不怕对抗，后来越来越觉得就加了一些，会打的打TOUCH的时候相互之间有配合，因为我特别享受那种两个人配合怕怕怕配合传球最后突破的这种感受我特别享受。

In a similar vein as both Wang and Yang, Han's animated description of the feeling of "two people coordinating (pa-pa-pa)" elicits a positive emotional valence surrounding moments in which expectations around performance are either met or exceeded. When I later asked Wang Zhengfeng about the experience

of successful team performance he offered an animated description in which he suggested that *moqi* was often analogous to the experience of his first successful sidestep, albeit at the level of the team:

It's really hard for me to say what it feels like. It feels just like a fight for life or death, like you must win the match. Normally, that sort of tacit understanding sometimes isn't there, but then suddenly you coordinate on the field and you can form this feeling. You haven't given much consideration as to how to play...its probably also to do with the feeling of time spent together, the few of us know each other's characteristics, we understand each other relatively well. Its like sidestepping, suddenly you can get that feeling of tacit understanding.

还真说不出来是什么感觉。就是感觉生死战一样，必须要拿下来他。那种默契平时有的时候没有，在场上突然配合就感觉打上来了这种感觉。没有考虑太多怎么打，可能也是时间长的感觉，我们几个知道自己的特点，彼此可能比较了解，跟变相一样，突然就出来了那种默契的感觉

These excerpts from interview offer support for the claim that more positive violations of expectations surrounding team performance may be associated with experiences characteristic of team click (H2b). In addition, more positive violations of expectations surrounding team performance may arise in situations in which the uncertainty of joint action is higher (H2a)

5.4 Discussion

This chapter presented results relating to athletes' perceptions of team click and experience of joint action more broadly. Results showed strong evidence for team click as a visceral and socially agentic phenomenon closely associated with processes characteristic of social bonding. Meanwhile, analysis of athletes' experience of joint action reveals that many athletes experienced performance-related stress and anxiety, as well social guilt. More senior athletes displayed a capacity to deploy on- and off-field strategies to defray the personal costs of rugby's joint action. Opportunities for strategy and deflection of responsibility appeared to be less available to junior athletes who, by contrast, tended to admit personal shortcomings and personal responsibility poor on-field performance. Results of an informal survey

study support this suggestion, by indicating that 1) training sessions involving high-intensity and on-line joint action (i.e., “Game Play”) may be experienced as more stressful compared with training sessions involving similar levels of physiological exertion but less complex joint action requirements. It also appeared that more junior athletes may have been more prone to performance-related concerns in complex on-line joint action scenarios. Together, this evidence serves to validate a number of claims of a general account of team click in group exercise, and motivates future research designed to directly test research hypotheses.

First, results generally validate further investigation of the core hypothesis of this thesis, that team click mediates a relationship between joint action and social bonding (H1). Athlete testimonies substantiate the theoretical claim outlined in Chapter 2.4.4, that team click entails two core dimensions, one involving visceral perceptions, and the other involving perceptions of (social) agency. Results also suggest a possible association between team click and social bonding, whereby the visceral and socially agentic sensations of team click are connected to more elaborate cultural affordances characteristic of group membership (which constitutes one dimension of social bonding) (H1b).

In addition, the prevalence of performance-related anxiety suggests that athletes’ athlete perceptions of team click may be sourced from an evaluation of team performance (H1a). This proposal is supported by evidence reported in Chapter 4.3, which suggests that athletes attend to technical components of team and individual performance. Evidence suggests that perceptions of individual performance will also be highly relevant to processes of performance evaluation and, possibly, processes related to team click. However, the theoretical claim that higher levels of uncertainty are associated with action that is “more-joint” (i.e., team performance) relative to action that is “less-joint” (i.e., individual performance) justifies a specific focus on team performance as a source of team click. Thus, based on the results of this ethnographic study, I infer that team click should mediate a relationship between more positive perceptions of team performance and social bonding in group exercise settings.

Results reported here also provide some validation of the secondary hypothesis of this thesis, that better-than-expected execution of joint action will mediate a relationship between higher levels of uncertainty and higher levels of team click (H2).

While I do not present evidence that directly substantiates the claim, it can be inferred from ethnographic observations that rugby's joint action may entail the experience of high levels of uncertainty, which may lead to lower expectations for success in team performance (H2a). A rationale for an association for uncertainty in rugby's joint action is provided in Chapter 4.3.1. The combination of perceived challenge and difficulty, stress and anxiety, and social guilt associated with on-field performance (including pressures exerted by key figures such as the team coach) suggests the possibility that many athletes may generate low expectations of success in on-field performance (both individual and team performance). In addition, clear evidence for experience of successful (individual and team) performance as positive and exhilarating suggested that more positive violations of expectations concerning performance may precede experiences of team click (H2b). By virtue of the fact that team performance appears to be perceived as more difficult and challenging relative to individual performance (see Chapter 4.3.1), it can therefore be expected that expectations for team performance success may be lower than individual performance success. In turn, expectation violation surrounding team performance will be higher in instances of successful performance in joint action, relative to positive violation of individual performance expectations.

Variation in responses to the uncertainty of joint action—ranging from shouldering responsibility for performance through to deflecting responsibility for poor performance to others, or basic heuristics of “just keep going” through to more nuanced on-field conservatism—appears to vary according to familiarity with the technical requirements of rugby. While evidence does suggest that more senior athletes are more able to manage the on- and off-field challenges of adherence to rugby at the Institute, it is not clear that this ability is necessarily due to increased levels of technical competence, although increased competence over time is likely to be a relevant factor among many others. Thus, from this evidence alone it is difficult

to infer any definitive answers to the question of the role of technical competence in managing the technical and social uncertainties of joint action (Research Question 3). However, natural within-group variation in seniority in the Beijing men's team did at least serve to render uncertainty in joint action visible, by virtue of a gradient of responses to joint action beneath which it could be inferred that uncertainty was one operative factor. Overall, while many important details concerning the underlying mechanisms of uncertainty in joint action remain unclear, evidence reported herein serves to encourage further investigation of 1) responses to uncertainty in joint action, and 2) positive expectation violation concerning team performance, as hypothesised by a general account of team click in group exercise.

In the following two empirical chapters, I present specific predictions and field studies designed to test a general account of team click in group exercise.

6

Team click in a National Tournament

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6.1 Introduction

Team click is a visceral and socially agentic experience of optimal team performance in joint action. The phenomenon of team click in group exercise contexts is anecdotally pervasive, but theoretical justifications and empirical substantiation for the mechanisms that generate team click are lacking. Thus, in this study, I tested a general account of team click by surveying a population of professional athletes before, during, and after a high-stakes, high-intensity rugby Tournament. It was hypothesised that, when levels of uncertainty were high—levels of uncertainty in joint action in the Tournament were presumed to be high—team click would mediate a relationship between more positive perceptions of team performance and higher levels of social bonding (H1). In addition, it was hypothesised that positive violation of expectation surrounding team performance will lead to higher levels of team click, and, in turn, social bonding (H2b).

Empirical and theoretical evidence outlined in Chapter 2 supported the core claim that team click will explain a relationship between positive perceptions of team performance and social bonding. Theory suggests that perceptions of team click may arise in situations in which the high levels of uncertainty in joint action are met with high levels of dynamical coordination—of both physical movement and social communication between co-actors (Semin & Cacioppo, 2008). In previous Chapters, ethnographic evidence suggested that the experience of uncertainty of joint action, and on-and off-field forms of coordination were present and salient dimensions of athletes daily experience at the Institute (see Chapter 4). In addition, I confirmed that athletes widely recognised and experienced team click in rugby’s joint action, albeit infrequently in the case of the Beijing rugby team (see Chapter 5). In particular, positive expectation violation appeared to precede team click, and team click appeared to prompt automatic appeal to social rationales for team performance. Taken together, this evidence supports the possibility that positive

expectation violation in joint action serves to draw attention to visceral and socially agentic perceptions of team click, for which social rationalisations characteristic of social bonding function to explain (H2). These findings validated research hypotheses and motivated further empirical research.

The Tournament

“The 2016 National Rugby Sevens Championship” (2016全国7人制橄榄球冠军赛; hereafter “The Tournament”) was a rugby sevens tournament held 16-17th July 2016 in Qianan, Hebei Province, China. Athletes competed for their provincial teams at high intensity and for high stakes (to be crowned overall National Champion) in a series of 14-minute rugby sevens games spread over two days. The athletes surveyed in the Tournament represented the top level of professional rugby players in China at the time. In this study, it was assumed that uncertainty in group exercise would be constantly high, and that varying levels of physical and social coordination would be present in response to this high uncertainty (see Chapter 2).

Survey measures

The key predictor variable of this study was athlete perceptions of *team* performance. Ethnographic evidence suggested that athletes would reflect on and scrutinise various technical components of joint action, which could be delineated as “more-joint” action and therefore more uncertain (team performance), and “less-joint” action and therefore less uncertain (individual performance); see Chapter 4.3. Thus, before and after the Tournament, athletes were asked to report their perceptions concerning performance of technical components of team (coordination in defence, attack, support play, on-field communication) and individual (passing technique, tackling, decision making, effectiveness in contact) performance. It was expected that athletes would reflect on team and individual performance as separate constructs. Additionally, measures of individual performance would be used as statistical controls in analyses of study predictions, to further distinguish perceptions of team-level contributions to joint action from individual-level contributions. To investigate the predicted role of positive expectation violations of team performance as a preceding

mechanism to team click and social bonding, athletes were also asked to report their perceptions of overall team and individual performance relative to prior expectations.

Team click was measured using a number of novel items designed capture the phenomenon's visceral and socially agentic dimensions (as outlined in Chapter 2.4.4). Viscerality was measured by questions about 1) *moqi* (a Chinese term specifically denoting tacit understanding, but also used to describe more general “click” in joint action), 2) team aura (*qichang* 气场; distinguished from atmosphere (*qifen* 气氛) to denote atmosphere specific to the team), and 3) a novel visual item designed to reflect perceptions of coherence in joint action. Social agency was measured by asking athletes to report perceptions of 1) their own abilities being extended by the abilities of their teammates, and 2) the perceived reliability of others (and self) to perform prescribed roles in joint action (two separate items).

Social bonding is known to entail a continuum of affective and more explicit or declarative processes, ranging from emotional connection to specific others, to more general attachment, to more culturally mediated affordances such as group identity (Dunbar & Shultz, 2010; Whitehouse et al., 2014). Accordingly, athletes were asked questions designed to access both affective and explicit ends of this continuum. Two novel measures were used to assess: 1) athlete perceptions of emotional support from teammates and 2) common goal with teammates (both more tacit, affective measures of social bonding). Athlete identification with the team was measured using a scale validated to measure identification of self with the prototypical features of the group (Group Identification, see Turner et al., 1987), as well as a scale validated to measure an individual's “visceral sense of oneness” or fusion with the group (Identity Fusion; see Swann et al., 2009)).

Together, these survey items were designed to operationalise hypothesised relationships between perceptions of team performance, team click, and social bonding. In general, athletes were asked to reflect on their “sense perceptions” or “feelings” (*ganjue* 感觉) associated with aspects of performance, team click, and social bonding. Feeling was used instead of “perception” (*zhijie* 直觉), to encourage athletes to reflect on their own personal sensorimotor impressions of participation

in joint action, and to reduce the extent to which athletes would appeal to more explicit or de-personalised explanations for team or individual performance (for example, sourced from feedback provided by their coach, or by objective measures of performance such as games won or lost).

Acknowledging the possibility that individual differences in technical competence and personality type may modulate the processes outlined above, this study also measured technical competence and personality type of athletes. Based on ethnographic evidence, it was expected that athletes with higher levels of technical competence would be more able to mitigate the uncertainty associated with rugby's joint action, and would therefore perceive higher levels of team click. Meanwhile, it was expected that higher levels of extraversion may serve as a proxy for a propensity shown by more extraverted individuals to ascribe agency in joint action to referents external to the self (Keller et al., 2014). Accordingly, measures of technical competence—both objective measures (e.g., training age and years spent in the team) and subjective measures (e.g., competence relative to other athletes)—and personality type were also recorded, based on the possibility that these variables may also bear upon perceptions of joint action in group exercise. However, owing the many unresolved questions in these literatures, these measures were examined as open questions, and no strict predictions were formulated.

In addition to these main variables of interest, perceptions of fatigue and injury were also recorded. Finally, data concerning athletes' objective performance in the tournament was also collected to enrich analysis and provide statistical control for variation in factors such as overall team performance in the Tournament, as well as an individual's overall time spent on the field and markers of performance during the Tournament (i.e., total minutes played; total points scored).

Three subsets of the collected data (Post-Tournament, Pre- to Post-Tournament, and Overall Tournament) were analysed for relationships between variables of interest within individuals and over time. Clustering of responses according to groupings such as sex, team, and repeated measures of individuals was assessed (and controlled for statistically where necessary).

In sum, this study aimed to test the core hypothesis of this thesis (H1), as well as aspects of the secondary hypothesis (H2). Specific predictions are outlined in Table 6.1.

Table 6.1: Tournament Survey Study Predictions

Predictions: Tournament Survey Study	
1.a	More positive perceptions of team performance will predict higher levels of team click
1.b	Higher levels of team click will predict higher levels of social bonding
1.c	More positive perceptions of team performance will predict higher levels of social bonding
1.d	Team click will mediate a relationship between more positive perceptions of team performance and social bonding
2.a	More positive perceptions of team performance relative to prior expectations will predict higher levels of team click
2.b	More positive perceptions of team performance relative to prior expectations will predict higher levels of social bonding

6.2 Method

6.2.1 Participants

174 Chinese professional adult rugby players from 8 men's provincial teams and 7 women's provincial teams ($M(age) = 21.67$ ($SD = 3.67$, $range = 16 - 32$, $male = 93$) were surveyed once before (2-4 days before), twice during (once each day of the two day tournament, following the 2nd or 3rd game of each day), and once after the Tournament. The University of Oxford's Central University Research Ethics Committee approved this study (SAME/CUREC1A/15-059).

6.2.2 Materials

6.2.2.1 The Tournament

In this study, 15 teams in total participated in the Tournament: 7 women's teams and 8 men's teams. The men's competition was split into two pools of 4 teams each, and the women's competition was split into one pool of 4 and one pool of 3 teams (see Table 6.3). A rugby sevens tournament is generally made up of 16 teams and requires two full days to complete. Within each tournament, participating teams are first divided into smaller pools (four teams per pool), and spend Day 1 of the tournament playing 3 14-minute games against each team in their pool. On Day 2 of the tournament, teams are re-grouped according to results from Day 1. The top 8 teams of the tournament compete for overall championship in a knock-out (winning teams advance, losing teams are knocked-out of further contention for overall winner, but may still contest lower placings) stage of the tournament, while any remaining teams outside the top 8 compete for the remaining placings below these 8 teams (WorldRugby, 2018). At the time that this study was conducted, the playing time for the grand-final was extended to 20 minutes (10 minutes per half, as opposed to the usual 7 minutes).

Women's tournament

Teams in Women's Pool A played only two games each on the first day, while teams in Women's Pool B played 3 games each. On the second day, the top two teams from

Table 6.2: Tournament pool structure for women's (left) and men's (right) tournaments.

	Women's Pool A	Women's Pool B	Men's Pool A	Men's Pool B
1	Jiangsu	Anhui	Shandong	Tianjin
2	Shandong	Shanghai	Beijing	PLA*
3	Tianjin	Beijing	Hebei	Anhui
4		Fujian	Shanghai	Fujian

Table 6.3: *PLA: People's Liberation Army

each women's pool competed in the women's knock-out (which consisted of only a semi-final and grand-final). The remaining 3 teams who did not qualify for the knock-out phase played each other once to determine the remaining places (5th-7th place). Therefore, athletes in the women's teams played 4 or 5 games spread over two days.

Men's tournament

Athletes in the men's team each played 3 games on day one, before playing in a knock-out phase on day two, which involved 8 teams in a quarter-semi-grand final structure. The winning teams from the quarter-finals played in a semi-final, and then either a grand final (for the two undefeated teams) or a 3rd-4th place playoff final (for the two losing teams from the semi-finals). The 4 teams who lost in the quarter-finals played in a subsidiary semi-final and final to decide the 5th-6th place and 7th-8th place results. Thus, athletes in the men's teams played a total of 6 games over two days.

6.2.3 Surveys

Surveys were designed primarily to measure athletes' perceptions of performance, team click, and social bonding in joint action. Surveys were generated using Qualtrics software (Qualtrics version 9, Provo, UT). Surveys were translated into Chinese and then back-translated by two independent native Chinese speaking translators from Beijing Sports University.

Surveys were administered at 4 different time points: once before, twice during, and once after the Tournament. Pre- and Post-Tournament surveys were

administered online using a social networking software called WeChat. Surveys administered before and after the Tournament were completed by athletes within the WeChat application, using their personal mobile phone devices and Internet access. Due to the constraints of the Tournament setting, in particular athletes' lack of access to mobile phones and Internet immediately following games, hard copy (paper) surveys rather than electronic surveys were administered Mid-Tournament.

6.2.3.1 Tournament Survey Items

Tournament survey items were designed and selected to collect data on 4 main areas of athlete experience. Questions included items on subjective experience of team and individual performance, feelings of team click, and feelings of social bonding to their team. In addition, athletes answered questions about exertion, fatigue, injury status, as well as objective and subjective measures of technical competence, perceptions of team discipline, and individual personality type (see Table 6.4). The surveys (initially designed in English) were translated into modern Chinese by the researcher and back translated by two independent native Chinese speaking translators from Beijing Sports University to verify accuracy.

Team and individual performance

To isolate athlete perceptions of team performance from perceptions of individual performance, athletes were asked to report perceptions of team and individual performance separately. Athletes reported their perceptions of two dimensions of performance: 1) components of performance (team and individual), and 2) overall quality of performance relative to prior expectations (team and individual). As in Chapter 6, components of team performance and components of individual performance were selected according to aspects of team performance commonly scrutinised in rugby (see Table 6.5).

In the Pre-Tournament survey, athletes were asked about their impression of team or individual performance in the past month, for example: "how do you feel about your team's coordination of the defensive line over the past month?" In the Post-Tournament survey athletes were asked about their impressions of the same

Table 6.4: Main survey items administered over the course of the Tournament. ID Variables included team, age, training age, etc.

Item	Pre	Day 1	Day 2	Post
Team Performance				
Components of Vs expectations	✓	✓	✓	✓
Individual Performance				
Components of Vs expectations	✓	✓	✓	✓
Team Click				
6 item survey	✓			✓
3 item survey	✓	✓	✓	✓
Social Bonding				
6 item survey	✓			✓
3 item survey	✓	✓	✓	✓
Moderators				
Fatigue		✓	✓	✓
Injury	✓	✓	✓	✓
Objective competence	✓			
Subjective competence	✓			
Personality	✓			
ID Variables	✓			

components of performance as they were perceived during the Tournament, e.g. “How do you feel about your passing technique during the Tournament?” Athletes responded to each item by moving a toggle left or right from its default centre position on a continuous 100-point scale: 0 - “Extremely poor”, 100 - “Extremely good.” Given the time constraints associated with delivering surveys during the Tournament itself (immediately following individual games), athlete perceptions of components of team and individual performance were only included in the Pre- and Post-Tournament surveys.

Items measuring athlete perceptions of overall quality of *team and individual performance relative to prior expectations* were included each Mid-Tournament survey, and in the Post-Tournament survey. In the case of the Mid-Tournament

Table 6.5: Components of team and individual performance administered Pre- and Post-Tournament

Performance	Technical Component	Item
Team	Defence	How do you feel about your team's coordination of the defensive line?
	Attack	How do you feel about your team's coordination of the attacking line?
	Support play	How do you feel about your team's support play?
	On-field communication	How do you feel about your team's on-field communication?
Individual	Passing technique	How do you feel about your passing technique?
	Support play in attack	How do you feel about your support play in attack?
	One-on-one defence	How do you feel about your 1on1 defence?
	Effectiveness in contact	How do you feel about your effectiveness in contact over the past month?
	Decision making in game play	How do you feel about your decision making in game-play?

surveys, athletes were asked: “Overall, how do you feel about your individual performance/the performance of the team in this game?” (100 point continuous scale centred at zero: -50 — “Much worse than expected”, 0 — “As expected”, 50 — “Much better than expected”). In the Post-Tournament survey, athletes answered the same questions about individual and team performance, but in relation to the Tournament as a whole.

In the Pre-Tournament survey, athletes answered questions relating to overall

team and individual performance in relation to the month of training and competition prior to date of the survey (“Overall, how well do you feel you/your team has been performing in training and competition over the past month?”). Without a specific or immediate focus for perceptions of overall performance, it was unnatural to frame these items in terms of prior expectations. Instead, overall performance was rated on a continuous scale (0 = “Extremely poor,” 100 = “Extremely well”). While these items did not provide a measure of performance in relation to prior expectations *per se*, they provided a baseline control measure of attitudes towards performance.¹

Team Click

Athletes responded to a number of questions regarding their experience of team click. Survey items pertaining to team click were generated by utilising concepts commonly encountered by the researcher during ethnographic observations of the Beijing provincial team and other Chinese provincial teams. Items measuring team click are displayed in Table 6.6. All items were novel measures. Athletes responded to each item by moving a toggle left or right from its default centre position on a continuous 100-point scale (0 — “Extremely weak,” 100 — “Extremely strong”).

Tacit Understanding is an English translation of a Chinese term *moqi*, which is often used in team sport contexts to express the idea of click in joint action (see Chapter 3.4 and 5.2). Team Aura *qichang* (气场), is a term taken from Chinese *qigong* (气功), literally meaning “field of energy.” *Qichang* is commonly used to describe the atmosphere generated when the team is performing well. The pictorial measure of team click was a visual item with 5 responses, ranging from less to more coordinated arrangements of dots, designed to represent the coordination of the team on the field (Click Pictorial, see Figure 6.1). For a detailed explanation of all Pre-Tournament survey items relevant to team click see Appendix E.1.2.1.

¹Unless otherwise stated, all Pre-Tournament survey items used “in the past month” as a time referent; Mid-Tournament survey items used “in this game,” and the Post-Tournament survey items used “in the Tournament” as time referents.

Table 6.6: Survey items designed to measure the experience of team click in joint action.

Item	Description
Viscerality	
Tacit Understanding	How strong has the tacit understanding been between team members?
Team Aura	How is the aura in/around the team?
Click Pictorial	<i>Visual Item</i>
Social Agency	
Reliability of Others	To what extent have you felt that you can rely on others to perform their roles on the field (for example, in key moments of competition or training)?
Reliability for Others	During the past month, to what extent have you felt that others can rely on you to perform your role on the field (for example, in key moments of competition or training)?
Ability Extended	When coordinating with others on the field in the past month, do you feel that your individual ability is extended by the ability of your team mates?

Only 3 items pertaining to team click were included in the Mid-Tournament survey due to time constraints (Tacit Understanding, Team Aura, and the Click Pictorial measure).

Social Bonding

Athletes answered items relating to feelings of social bonding to their team and teammates. Survey items related to social bonding are described in Table 6.7. Two novel measures of social bonding were constructed to reflect ethnographic results: Emotional Support and Common Goal. Both measures used 100-point continuous



Figure 6.1: Click Pictorial Scale

Table 6.7: Survey items designed to measure athlete experience of social bonding

Item	Description
Emotional Support	How emotionally supportive does the team feel?
Common Goal	How strong is the feeling that everyone is working towards a shared goal?
Group Identification Verbal Scale	<i>An individual’s personal identification with the stereotypical features of the in-group (see Mael 1992)</i>
Identity Fusion Verbal Scale	<i>A five item verbal scale designed to measure construct of Identity Fusion (see Swann et al. 2009)</i>
Identity Fusion Pictorial Scale	<i>A single item visual scale designed to measure construct of Identity Fusion to three target in-groups: an athletes’ 1) team, 2) family, and 3) nation (see Swann et al. 2009)</i>
Pictorial Rank	<i>The rank order in which athletes experience fusion to team, family, and nation (see Whitehouse et al. 2014)</i>

scales, (0 - “Extremely weak”, 100 - “Extremely strong”).

Group Identification and Identity Fusion items were validated multi-item constructs (5 and 7 items respectively) measured using 5-point Likert scales. The Fusion Pictorial scale is shown in Figure 6.2. See Appendix E.1.2.1 for a detailed explanation of all items relevant to social bonding. Given time constraints, only 3 items pertaining to social bonding were included in the Mid-Tournament survey (Emotional Support, Common Goal, and Identity Fusion Pictorial (Team)).

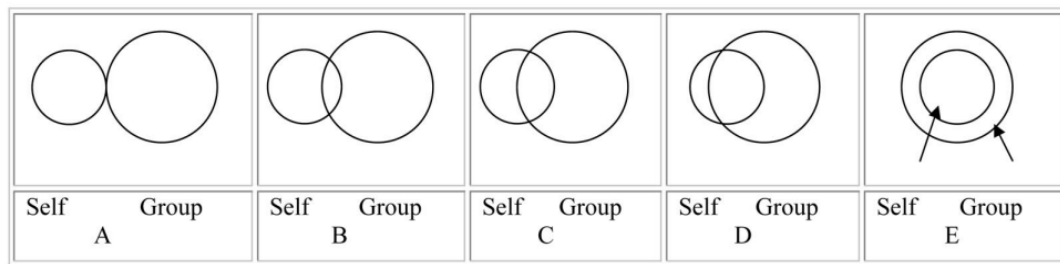


Figure 6.2: Identity Fusion Pictorial Scale

Moderator Variables

Fatigue, Exertion, and Injury Status: Following each Mid-Tournament survey and in the Post-Tournament survey, athletes were asked about their mood (including dimensions of arousal, excitement, and nervousness), feelings of fatigue (“How fatigued do you feel as a result of the game/tournament?”), perceived physical exertion (Borg RPE scale; Borg, 1990) and perceived mental exertion (see Noakes, 2012). Athletes were also asked about their injury status in each Mid-Tournament survey and in the Post-Tournament survey (see Appendix E.1.2.1).

Technical Competence: Athletes were asked to report their perceptions of individual technical competence relative to 1) other teammates, 2) other current professional Chinese rugby players, and 3) professional rugby players from other countries. Athletes also provided information on rugby-related attributes, which also provided a more objective indicator of technical competence. These measures included: 1) rugby training age (number of years of experience training for rugby, to the nearest number of years), 2) the number of years spent training with the provincial teams (to the nearest year) and 3) whether the athlete is a usual member of the provincial program’s starting team or the reserves. See Appendix E.1.2.1 for a detailed explanation of all items relating to technical competence.

Personality: A 10-item personality measure was included in the Pre-Tournament survey to measure athlete personality type according to the “Big 5” personality types (Ten Item Personality Index - TIPI. The 5 types are: Extraversion, Agreeableness, Conscientiousness, Emotional Stability (Neuroticism reverse coded), and Openness

Table 6.8: Measures of objective performance in the Tournament

Item	Description
Final rank	A rank was given to each team based on performance in their respective competition (men's and women's)
Wins - losses	A team's total number of losses was subtracted from its total number of wins
Total minutes	Total number of minutes played throughout the Tournament by each individual athlete
Total points	Total number of points scored throughout the Tournament by each individual athlete
Starting team	An average measure indicating likelihood of an athlete being selected in the starting team.

to Experiences; see Gosling, Rentfrow, & Swann, 2003). See Appendix E.1.2.1 for a detailed explanation.

Identification Variables

In the Pre-Tournament survey athletes were asked about basic identification variables (athlete name, date of birth, team membership, etc). For a detailed description of additional items included in the Tournament surveys, see Appendix E.1.2.

6.2.3.2 Measures of objective performance

Following the completion of the Tournament, tournament officials from the Chinese Rugby Football Association (CRFA) provided performance data in electronic format. These data included results for each game, minutes played and points scored by individual athletes in each game, substitutions made during each game, and video footage of every game played during the Tournament. Based on the data provided, a number of objective performance variables were created for use as statistical controls (described in Table 6.8).

6.2.4 Procedure

6.2.4.1 Pre-Tournament survey

Two months prior to the Tournament, I contacted the head coach of each provincial team and officials from CRFA to seek permission for the study. After receiving permission from all participating teams and CRFA, 5 days prior to the Tournament I asked the coach or manager of each team to create a virtual message group on WeChat, the members of which included the coach/manager of the team, the athletes competing in the Tournament, and the researcher. The WeChat group could be accessed by the athletes on their personal mobile phone devices with Internet connection. Once the WeChat group was set up, I posted a standard message in each group in which I introduced the study and provided the link to the Qualtrics survey for the athletes to complete in their own time (for English and Chinese versions of the script, see Appendix E Section E.1.1.1).

Upon opening the link to the survey, athletes read a detailed brief about the survey, provided consent, and demonstrated their ability to answer the survey questions by changing the position of a virtual sliding bar toggle that would feature in many of the survey questions. Athletes were then asked a number of questions grouped by the following categories: perceptions of team and individual performance, team click, social bonding, technical competence, and personality type. The order in which each item appeared within these categories was randomised for each survey participant. At the end of the survey, athletes were asked to provide basic identification variables such as age, sex, team, position, and injury status. The Pre-Tournament survey took approximately 15 minutes to complete. Once the data collection window for the Pre-Tournament survey had ceased, survey responses were collated in Qualtrics.

6.2.4.2 Mid-Tournament surveys

Copies of the Mid-Tournament survey were printed on A4 paper for athletes to complete with a pen or pencil within 30 minutes of the end of the second or third game of each day. All surveys were administered and collected by the researcher,

occasionally with minimal assistance from team staff who handed out surveys or pens. After receiving permission from the team coach or manager, I approached each team approximately 10-20 minutes following the completion of the game, and administered a hard copy of the Mid-Tournament survey to each athlete. Data collection occurred on the side of the Tournament field after athletes had completed their cool-down routines. The Mid-Tournament took approximately 3 minutes to complete. Completed surveys were collected by the researcher and sealed in envelopes labelled by team. Athletes were surveyed following the second game of each day (or in the case of two of the teams, following the third game of Day 1, and the second game of Day 2). Survey responses were later manually collated and data were imputed into a .csv file using Microsoft Excel (Version 14.7.1). An hypothesis blind research assistant performed an accuracy check on manually imputed survey data by randomly sampling 20 Mid-Tournament surveys and ensuring agreement with .csv file for one survey item per each main variable of interest (team performance, team click, social bonding, technical competence, and personality).

6.2.4.3 Post-Tournament survey

The Post-Tournament survey was administered via the same WeChat group that was set up for the Pre-Tournament survey. Data collection for the Post-Tournament survey began the day after the completion of the Tournament, and finished 4 days later. Athletes were asked to respond to survey items framed in terms of their experience of the Tournament.

6.2.4.4 Performance data

Following the completion of the Tournament, game-by-game performance data were collected from the CRFA Tournament statistician. Data were stored on an encrypted external hard disk. These data were later manually imputed into a data frame in Microsoft Excel, before being imported into RStudio to be merged with other survey data (Pre-tournament survey, Mid-Tournament surveys, Post-Tournament surveys, and Post-Tournament survey) for statistical analysis.

Survey responses and tournament performance data were collated and imported into RStudio (Version 1.0.136), where they were cleaned and reorganised for statistical analysis. Collated data were then combined with other survey and performance data to be analysed in RStudio.

6.3 Data analysis

6.3.1 Roadmap for analysis of study predictions

The predictions of this study were analysed using 3 subsets of the collected data: 1) Post-Tournament, 2) Pre- to Post-Tournament, and 3) Overall Tournament. Post-Tournament data were analysed for a relationship between perceptions of team performance, team click, and social bonding following the tournament. Pre- to Post-Tournament data were analysed for a *change* in variables of interest as a result of the Tournament. The Overall Tournament dataset (i.e., Pre-, Mid-, and Post-Tournament surveys combined) was analysed to ascertain whether the predicted relationships between variables of interest were consistent throughout the Tournament for individuals. By analysing multiple observations for the same athlete over a number of time points, it was possible to better account for intra- and inter-individual variation in the collected data, enabling more robust inferences regarding study predictions.

6.3.1.1 Data structure and model selection

The *in situ* nature of this study meant that the collected data contained multiple levels of dependency: observations from multiple time points were nested within the same individual athlete; athletes were nested within their respective teams; teams were nested within the men's and women's competitions (i.e., according to sex). In addition, the data were unbalanced, meaning that an uneven number of observations were recorded for each of the 15 teams over 8 separate time points at which data were collected. Linear mixed-effects regression (LMER) models were thus used to avoid the violation of the assumptions of independence and equality of variance due to dependencies, and at the same time deal with the problem of missing data (Quené & Van Den Bergh, 2004; Field, Miles, & Field, 2012). The LMER can be expressed in notation form as follows:

$$Y_{ij} \sim (\beta_0 + u_{0j}) + (\beta_1 + u_{1j})X_{ij} + \varepsilon_{ij} \quad (6.1)$$

$$\varepsilon_{ij} \sim \mathcal{N}(0, \sigma^2) \quad (6.2)$$

Where Y_{ij} denotes the i^{th} observation for group j , $(\beta_0 + u_{0j})$ denotes the fixed and random intercept, $(\beta_1 + u_{1j})$ the random and fixed slope, and ε_{ij} denotes the error term. Errors are assumed to be normally distributed with mean of zero. The random structure of the model (j) was determined by assessing Intra Class Correlation (ICC) values for main group-level variables of interest: team, competition (men's or women's), or individual athlete (in the case of repeated measures analyses).

For the following analyses, multilevel linear models were fit with Maximum Likelihood parameter estimation method using the *lme4* package (Bates and Sarkar, 2006) in the R environment (R Development Core Team, 2006). Model fit was judged by comparing the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). In addition, marginal and conditional R^2 values of equivalent models were compared and used as an indication of model effect size.²

Unless otherwise stated, all LMER models controlled for individual performance, technical competence, objective performance measures (final performance rank of team in the Tournament, total individual points scored, average appearances in the starting team), fatigue and personality (Extraversion).

Data manipulation for Pre- to Post-Tournament analysis

The number of observations available in the Pre-Post Tournament data were insufficient to construct a mixed-effects repeated measures design in which both the intercept and slope of observations could vary according to each individual athlete nested within their given team over time.³ Alternative models for suitable

²Nakagawa and Schielzeth (2013) have proposed a formula for calculating the proportion of variance explained by the fixed factor of the model (marginal R^2 , compared to an intercept-only or null model), and the proportion of variance explained by the combination of the fixed factor plus the random factor, (conditional R^2 , compared to the null).

³Allowing both the intercept and slope to vary requires twice the number of observations to estimate the random effects ($2 \times 174 = 248$), whereas the available number of observations was only 198.

for repeated measures designs, such as RM-ANOVA or ANCOVA, are incapable of allowing each fixed factor (the regression coefficient or slope) to vary randomly according to higher level factors (individual and team), and are also unable to handle unbalanced designs. As a compromise, change scores in variables of interest (individual and team performance, team click, social bonding, and fatigue) were calculated by subtracting Pre- from Post-Tournament scores for each athlete. The calculation of change scores reduced the complexity of the data structure down to two levels of analysis (individual athlete and team), and meant that relationships between these change variables could be modelled using a linear mixed effects regression. Change scores of relevant factors were introduced to the model as fixed effects, and their slopes and intercepts were allowed to vary according to team (random effect).

In regards to analysis of Prediction 2.a and 2.b, it was not possible to directly compare the Pre- and Post-Tournament measures of Team Performance Vs Expectations, given that the item measuring athlete perceptions of overall team performance in the Pre-Tournament survey was not framed in terms of expectation violation (but instead in terms of more or less “good” or “poor”). Instead, the Post-Tournament measure of Team Performance Vs Expectation only was used to predict change in feelings of team click between Pre- and Post-Tournament measurements.

Constraints of the Overall Tournament data

The items administered to athletes during the Mid-Tournament were reduced to accord with athlete schedules and convenience following games. As such, variables available for analysis in the Overall Tournament data were limited to those that appeared in the Mid-Tournament surveys. Time constraints meant that components of performance were not assessed in the Mid-Tournament survey, and only appraisals of overall individual and team performance relative to prior expectations were included. The Mid-Tournament survey contained 3 Team Click items (Unspoken Understanding, General Atmosphere, and Click Pictorial), and 3 Social Bonding items (Emotional Support, Shared Goal, and Fusion Pictorial) among other items.

Mediation analysis

To test the prediction that team click mediates a relationship between team performance and social bonding, mediation analyses were conducted using linear mixed effects regressions in the Causal Mediation Analysis package in R (Version 4.4.5). To make inferences concerning the average indirect and total effects, quasi-Bayesian Markov Chain Monte Carlo (MCMC) method based on normal approximation and 1000 simulations was used to estimate the 95% Confidence Intervals (Tofighi & MacKinnon, 2016; Imai, Keele, & Tingley, 2010). MCMC estimation is a form of non-parametric bootstrapping whereby the sampling distribution for the effect of interest is not assumed to be normal but is instead simulated from the model estimates and their asymptotic variances and covariances (Preacher & Hayes, 2008). For a full justification for, and methods associated with mediation analysis, see Appendix E.2.2.3.

6.3.2 Data Reduction

To make analysis of predicted relationships more tractable and parsimonious, data reduction was required. Data reduction allows for a reduction in multicollinearity between predictor variables of interest while retaining as much variance as possible in the observed data (Yong & Pearce, 2013). The survey items of this study were designed to collectively access latent psychological constructs (e.g., Team Click and Social Bonding). As such, a data reduction technique capable of modelling the theoretical structure of these data was preferred over a procedure that merely reduced the collected data to its common variance. Exploratory Factor Analysis (EFA) was thus chosen as the most suitable data reduction technique over Principal Component Analysis (for a full explanation of EFA, and a more detailed justification for EFA over other available techniques, see Appendix E.2.1.1).

An EFA was performed for each subset of the data (Post-Tournament, Pre- to Post-Tournament change, and Overall Tournament), to reduce data to key variables of interest: components of team and individual performance, team click, social bonding, and technical competence (objective and subjective measures).

Measures relating to exertion and fatigue were also consolidated as a factor. Prior to factors being extracted, correlation matrices of each group of variables were subjected to two common sampling adequacy measures: the Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity. Factor loadings of $> .3$ were considered adequate, and only items that loaded on one factor were accepted (Field et al., 2012). Sum of Squares Loadings (SS Loadings) for each factor were also reported (Dziuban & Shirkey, 1974). Finally, two reliability measures (Guttman's λ and Cronbach's α) were reported to provide estimates of the average correlation of all items that could pertain to the underlying construct (values $> .5$ were considered acceptable; see Benton, 2015; Tabachnick & Fidell, 2007). Factor scores were calculated as standardised z-scores with a mean of approximately zero, and standard deviation of approximately one.

6.3.2.1 Team Performance Components and Individual Performance Components

The theoretical predictions of this dissertation concentrate in particular on athletes' team-level perceptions of joint action (see Chapter 3.3.1.1). As such, perceptions of individual and team components of performance were analysed separately. This separation allowed for concentration on perceptions of individual and team performance on team click and social bonding. In addition, perceptions of success in individual performance components were used as a statistical control for perceptions of success in team performance.

6.3.2.2 Perceptions of team performance relative to prior expectations

The predictor variable of interest for Prediction 2.a and 2.b, perceptions of team performance relative to prior expectations, was a single item measure, and did not require data reduction. Given that many of the other outcome variables of interest were transformed (via EFA) into standardised z-scores ($mean \approx 0, SD \approx 1$), perceptions of team performance relative to prior expectation was also standardised ($mean \approx 0, SD \approx 1$) for consistency and accurate generation of estimates within subsequent linear mixed effects models (Bates, Mächler, Bolker, & Walker, 2015).

6.4 Results

6.4.1 Descriptive Statistics

6.4.1.1 Participants

Data were collected for 174 adult rugby playing athletes (*male* = 93, $M(\text{age}) = 21.67$, $SD = 3.67$, $\text{range} = 17 - 32$) across 8 time points. Objective performance data were collected after each of the 6 games for all 174 athletes who participated in the Tournament; survey responses were recorded for a total of 165 unique athletes at 4 different time points: once Pre-Tournament, twice during the Tournament, and once Post-Tournament (see Table 6.9).

Of the 174 athletes competing in the Tournament, 120 were surveyed during a 4 day window before the Tournament (69% of the total sample, *male* = 68). On Day 1 of the Tournament, a total of 151 athletes (87% of sample, *male* = 68) were surveyed: 129 athletes (*male* = 60) in 11 teams were surveyed after their 2nd game of the day, and 22 athletes (*male* = 8) in two teams were surveyed after their 3rd game. Two of 11 teams (Hebei men's and Fujian men's) were not surveyed due to timing and logistical constraints. On Day 2 of the Tournament, a total of 163 athletes (94% of sample, *male* = 91) in 14 teams were surveyed after their second game of the day. One team (Shanghai Women's) was not surveyed due to timing and logistical constraints. A total of 100 athletes (57% of the sample, *male* = 59) completed both the Pre- and Post-Tournament surveys, and a total of 99 athletes completed all 4 surveys (57% of the sample, *male* = 59). Logistical challenges relating to data collection meant that observations were missing for athletes across the 4 survey time points. Missingness in the survey data ranged from 15-19% at any one of the 4 survey time points.

6.4.1.2 Variables of interest over time

Table 6.10 displays the basic summary statistics (mean and standard deviation) for variables of interest collected at 4 time points during the Tournament. The central tendency of variables within the categories of performance, team click, social

Table 6.9: Survey and objective performance data collected at each time point during the Tournament

Time	Survey (Men, Women)	Objective Performance (Men, Women)
Pre-Tournament	120 (68, 52)	-
Day 1		
Game 1	-	174 (93, 81)
Game 2	129 (60, 69)	174 (93, 81)
Game 3	22 (8, 14)	174 (93, 81)
Day 2		
Game 4	-	174 (93, 81)
Game 5	163 (91, 72)	174 (93, 81)
Game 6	-	174 (93, 81)
Post-Tournament	118 (65, 53)	-

bonding, and fatigue and exertion were above the mid-point of each scale. In addition, Mid-Tournament measurements tended to be lower than Pre- or Post-Tournament measures for each category.

In relation to performance measures, athletes appeared on average to be more critical of their own and their team's performance (relative to prior expectations) when surveyed immediately after games on Day 1 and Day 2 than they were following the completion of the Tournament (note, however, that survey items relating to individual and team performance administered Pre-Tournament were not posed in relation to athlete expectations, and thus could not be directly compared to subsequent Mid- and Post-Tournament measures). The same pattern was identifiable in team click variables, with the central tendency of Mid-Tournament measures of Tacit Understanding and Team Aura 10-15% lower than Pre- or Post-Tournament measures. This is also the case for variables related to social bonding: Emotional Support and Common Goal in particular showed a steep increase from Mid-Tournament measurements to the Post-Tournament measurement. The same pattern was identifiable for variables relevant to fatigue.

Table 6.10: Mean (SD) of key variables of interest measured at Pre-Tournament (n = 120), Day 1 (n = 149), Day 2 (n = 163), and Post-Tournament (n = 118).

Item	Pre	Day 1	Day 2	Post
Team Performance				
Vs expectations	71.11 (21.87)	54.43 (30.63)	53.19 (32.98)	64.36 (23.61)
Attack	66.00 (24.95)	-	-	65.33 (20.26)
Defence	65.06 (22.85)	-	-	62.42 (22.50)
Communication	62.37 (24.21)	-	-	65.25 (21.26)
Support play	64.36 (23.53)	-	-	65.75 (19.72)
Individual Performance				
Vs expectations	68.92 (21.32)	39.43 (27.25)	40.92 (27.93)	56.36 (23.47)
Passing technique	65.74 (24.94)	-	-	58.41 (24.25)
1 on 1 defence	59.21 (26.64)	-	-	57.64 (23.57)
Effectiveness in contact	65.66 (24.85)	-	-	62.15 (24.81)
Support play	69.54 (23.23)	-	-	62.62 (22.70)
Decision making	65.48 (23.80)	-	-	61.22 (21.43)
Team Click				
Tacit understanding	71.58 (20.77)	55.92 (26.88)	55.30 (29.43)	72.72 (19.95)
Team aura	75.51 (23.27)	65.74 (31.95)	64.32 (33.39)	78.45 (21.34)
Click Pictorial	3.87 (1.24)	3.46 (1.49)	3.33 (1.70)	3.93 (1.04)
Reliability of others	67.43 (28.01)	-	-	68.00 (23.09)
Reliability for others	62.38 (25.40)	-	-	63.45 (25.80)
Ability extended	70.45 (25.83)	-	-	72.25 (19.27)
Social Bonding				
Emotional support	70.12 (26.21)	67.29 (30.56)	67.53 (32.55)	79.67 (18.84)
Common goal	77.66 (24.28)	76.34 (30.50)	71.42 (35.47)	86 (15.56)
Fusion (Pictorial)	4.26 (1.25)	4.06 (1.47)	3.85 (1.69)	4.33 (1.19)
Fusion (Verbal)	4.03 (.74)	-	-	4.00 (.71)
Group Identification	4.34 (.78)	-	-	4.29 (.67)
Other				
Fatigue	-	55.04 (24.94)	62.26 (24.37)	69.27 (21.24)
Injury status	81.28 (23.36)	79.70 (22.45)	73.29 (29.86)	76.14 (26.91)

6.4.2 Data Reduction

6.4.2.1 Perceptions of performance

Post-Tournament

Items concerning team components of performance (team defence, team attack, team support play, and on field communication) were subjected to EFAs. Correlations between team component performance items were very high (all $r's > .5$), which suggested that one factor would be appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .79$, $\chi^2(6, N = 118) = 342.14$, $p < .001$). One factor, labelled "Team Performance Components" was imposed on the data, which explained 72.8% of the overall variance ($SS_{Loading} = 2.91$). $Guttman's \lambda = .90$ and $Cronbach's \alpha = .91$ indicated that the data reduction was appropriate and reliable.

Items relating to individual component performance (passing technique, support play in attack, effectiveness in contact, 1on1 defence, and decision making in attack) were subjected to an EFA. Correlations between individual component performance items were also very high (all $r's > .5$), which suggested that one factor would be sufficient (confirmed by sampling adequacy tests, $KMO = .84$, $\chi^2(10, N = 118) = 326.38$, $p < .001$). One factor, labelled "Individual Performance Components" explained 62.1% of the overall variance ($SS_{Loading} = 3.10$). $Guttman's \lambda = .88$ and $Cronbach's \alpha = .89$ both indicated that the data reduction was appropriate.

To confirm that the theoretically motivated separation of Team Performance Components from Individual Performance Components was appropriate for the collected data, a follow up EFA was conducted, in which team and individual performance component variables were combined in one matrix. Sampling adequacy measures indicated high suitability ($KMO = 0.83$, $\chi^2(36, N = 118) = 726.60$, $p < .01$). As expected, an EFA extracted two factors: Individual performance measures loaded on one factor (proportion of variance = .34, $SS_{Loading} = 3.09$), and team performance measures loading on a second factor (proportion of variance = .32, $SS_{Loading} = 2.90$). $Guttman's \lambda = .93$ and $Cronbach's \alpha = .90$ indicated that the data reduction was appropriate.

Pre- to Post-Tournament

Correlations between components of team performance were very high (all $r's > .65$), and the suitability of the correlation matrix for factor extraction was confirmed by sampling adequacy tests ($KMO = .82$, $\chi^2(6, N = 238) = 717.55$, $p < .001$). As such, one factor (“Team Performance Components Change”) was imposed on items concerning team component performance, which explained 74.5% of the overall variance in items relating to team performance (SS Loading = 2.97). $Guttman's \lambda = .90$ and $Cronbach's \alpha = .92$) indicated that the data reduction was appropriate. Correlations between 5 items relating to individual performance were also sufficiently high (all $r's > .45$, $KMO = .83$, $\chi^2(10, N = 238) = 633.82$, $p < .001$), suggesting that one factor would be appropriate for individual performance. One factor (“Ind Performance Components Change”) was imposed, which explained 59.9% of the overall variance (SS Loading = 2.99). $Guttman's \lambda = .87$ and $Cronbach's \alpha = .88$ indicated that the data reduction was appropriate.

Overall Tournament

Athlete perceptions of components of performance were not administered in the Mid-Tournament surveys, and thus were not eligible for Overall Tournament analysis.

6.4.2.2 Team Click

Post-Tournament

All 6 items relevant to team click were included in an EFA: Tacit Understanding, Team Aura, Team Click Pictorial, Reliability Of Others, Reliability For Others, and Abilities Extended. Medium to strong correlations between variables of interest ($r's > .3$) and sampling adequacy measures suggested that imposing one factor was appropriate, $KMO = .69$, $\chi^2(15, N = 118) = 182.73$, $p < .001$. One factor labelled “Team Click” was extracted from the data, which explained 34.5% of the overall variance ($SSLoading = 2.07$). Guttman's $\lambda = .76$ and Cronbach's $\alpha = .75$ indicated that the data reduction was appropriate. These reliability statistics provided confidence that the novel pictorial click measure related strongly

to the ethnographically derived click items (for example, Tacit Understanding and Team Aura).

Pre- to Post-Tournament

Pre- and Post-Tournament measures of the same 6 team click items were collated and subjected to EFA. Correlations between variables were moderate to high, indicating that one factor was suitable (all r 's $> .3$, $KMO = .78$, $\chi^2(15, N = 238) = 336.41$, $p < .001$). One factor, "Team Click Change", was imposed, which explained 37.6% of the overall variance (all items loadings $> .4$, SS Loading = 2.26). *Guttman's* $\lambda = .76$ and *Cronbach's* $\alpha = .76$ indicated that the data reduction was appropriate.

Overall Tournament

Tacit Understanding, Team Aura, and Click Pictorial—the 3 team click items that were included in all 4 surveys—were subjected to EFA. Correlations between variables were high, suggesting that imposing one factor was appropriate (all r 's $> .62$, $KMO = .7$, $\chi^2(3, N = 440) = 723.67$). The factor "Team Click Tournament" explained 70.3% of the variance (SS Loadings = 2.11). *Guttman's* $\lambda = .83$ and *Cronbach's* $\alpha = .87$ indicated that the data reduction was appropriate.

6.4.2.3 Social Bonding

Five survey items related to social bonding (Emotional Support, Common Goal, Identity Fusion Verbal Scale, Group Identification Verbal Scale, and the Identity Fusion Pictorial (Team, Family, Country) were subject to data reduction.

Post-Tournament

Correlations between 5 social bonding variables indicated that Group Identification Verbal Scale did not share common variance with other variables (all correlations were $< .1$, except for the verbal measures of Identity Fusion ($r = .36$). As such, Group Identification was excluded from analysis. Sampling adequacy variables suggested that the remaining subset of variables were appropriate for analysis, $KMO = .65$, $\chi^2(10, N = 118) = 108.22$, $p < .001$. EFA was performed on

4 remaining items, imposing one factor labelled “Social Bonding”, which explained 34.5% of the overall variance ($SS_{Loading} = 1.60$, $Guttman's \lambda = .66$ and $Cronbach's \alpha = .65$).

Pre- to Post-Tournament

The same 4 survey items related to feelings of social bonding were subjected to EFA. Correlations between variables were generally high (all $r's > .3$, $KMO = .66$, corrtest Bartlett: $\chi^2(6, N = 238) = 218.95$, $p < .001$), indicating that one factor would be appropriate. One factor, labelled “Social Bonding Pre Post” was extracted, which explained 41.9% of the overall variance ($SS_{Loading} = 1.68$). $Guttman's \lambda = .68$ and $Cronbach's \alpha = .71$ indicated that the data reduction was appropriate.

Overall Tournament

The 3 social bonding variables that featured consistently in all surveys (Emotional Support, Common Goal, and Fusion Pictorial) were subjected to EFA. Correlations between variables were high, suggesting that imposing one factor was appropriate (all $r's > .63$, $KMO = .71$, $\chi^2(3, N = 440) = 759.30$, $p < .001$). The factor imposed for Social Bonding (“Social Bonding Tournament”) explained 71.7% of the variance ($SS_{Loadings} = 2.15$), and $Guttman's \lambda = .84$ and $Cronbach's \alpha = .88$ indicated that the data reduction was reliable.

6.4.2.4 Technical Competence

Eight items relevant to technical competence were analysed in a correlation matrix to assess relatedness. Medium correlations among measures of objective competence (three out of 4 items correlated at $> .3$) and among measures of subjective competence (all items except for team competence measure correlated at $> .3$) suggested that the data could be explained by two underlying factors. Team Ability Chinese Provinces was dropped from analysis due to low correlation with other competence variables, possibly because the item did not ask about an individual athlete's competence (it referred instead to an athlete's opinion of the competence of the team of which they were a member). An examination of the KMO measure

of sampling adequacy ($KMO = .67$), and the Bartlett sphericity test indicated that two factors were adequate, $\chi^2(21, N = 120) = 239.71, p < .001$.

An EFA of technical competence variables revealed that items of interest loaded on two factors. The exception was the variable Starting Reserve, which failed to load on either factor, and was thus dropped from analysis. Measures of objective competence (Years Team, Training Age, and Age) loaded on the first factor, which was labelled “Objective Competence” because the measures were all objective markers of an athlete’s competence. Objective Competence explained 26.4% of the total variance ($SS_{Loading} = 1.85$). The remaining measures of subjective competence (Ability Teammates, Ability Chinese Pros, Ability International Pros) loaded on the second factor. The second factor was labelled “Subjective Competence”, due to the fact that all measures were the product of subjective self-report. Subjective competence explained 23.8% of the variance ($SS_{Loading} = 1.67$). $Guttman's \lambda = .74$ and $Cronbach's \alpha = (.67)$ indicated that the data reduction was appropriate and reliable.

6.4.2.5 Additional data reduction

Data reduction on survey items pertaining to perceptions of fatigue and exertion (hereafter Fatigue) are reported in full detail in Appendix E.3.2.1.

6.4.2.6 Correlations between key factors of interest

Correlations values of factors of interest are shown in Tables 6.11 and 6.13. In the Post-Tournament and Pre- to Post-Tournament subsets, correlation values for outcome variables of team click and social bonding were moderate to high, but less than a generally accepted threshold of .70 (Field et al., 2012). In the Overall Tournament subset, the correlation value between team click and social bonding was .75, suggesting that models in which team click predicts social bonding in the Overall Tournament subset should be treated with caution.

Table 6.11: Tournament Survey Correlation Matrix (Post)

	Team Performance Components	Team Performance vs Expectations	Indiv. Performance Components	Indiv. Performance vs Expectations	Team Click	Social Bonding
Team Performance Components	1	0.65	0.49	0.3	0.69	0.41
Team Performance vs Expectations		1	0.38	0.48	0.56	0.32
Indiv. Performance Components			1	0.39	0.4	0.26
Indiv. Performance vs Expectations				1	0.26	0.19
Team Click					1	0.65
Social Bonding						1

	Team Performance Components	Team Performance vs Expectations	Indiv. Performance Components	Indiv. Performance vs Expectations	Team Click	Social Bonding Change
Team Performance Components	1	0.49	0.46	0.17	0.62	0.32
Team Performance vs Expectations		1	0.32	0.45	0.32	0.17
Indiv. Performance Components			1	0.44	0.29	0.04
Indiv. Performance vs Expectations				1	0.06	0.01
Team Click					1	0.37
Social Bonding Change						1

Table 6.12: Tournament Survey Correlation Matrix (Pre-Post)**Table 6.13:** Tournament Survey Correlation Matrix (Overall)

	Team Performance vs Expectations	Indiv. Performance vs Expectations	Team Click	Social Bonding
Team Performance vs Expectations	1	0.47	0.24	0.16
Indiv. Performance vs Expectations		1	0.19	0.08
Team Click			1	0.75
Social Bonding				1

6.4.3 ICC values

Post-Tournament

Computing ICC values for the Post-Tournament factors of interest identified team-level clustering in the data for Team Performance Components ($ICC = .37$), Individual Performance Components ($ICC = .22$), Team Click ($ICC = .30$), Social Bonding ($ICC = .10$) and objective measures of technical competence ($ICC = .36$). ICC values indicated only trivial clustering according to sex all $ICC < .10$, except for the ICC for Individual Performance Components, which was .11). As such, team (but not sex) was included in subsequent models as a random effect (for a detailed assessment of the group-level dependencies in the collected data, see Appendix E.2.2.2).

6.4.3.1 Pre- to Post-Tournament ICC Values

Team-level clustering was identified for Team Performance Components ($ICC = .15$), Individual Performance Components ($ICC = .32$) and Team Click ($ICC = .16$). Social Bonding ($ICC = .01$) did not exhibit within-group variance relative to between group variance. ICC values for sex were trivial (all $ICC < .10$).

6.4.3.2 Overall Tournament ICC Values

All ICC values for Team and Tournament were trivial (all $ICC < .10$).

6.4.3.3 Random effects

Based on these ICC values, Team was included as a random effect for Post-Tournament and Pre- to Post-Tournament models. Specifically, the intercepts and slopes of the response variable were allowed to vary according to team (i.e., random intercept model, see Pinheiro and Bates (2000); for an application, see Oberauer and Kliegl (2006)). Specifying Team as a random effect helped statistically account for clustering of observations within teams.

For the Overall Tournament analysis, neither team nor tournament were included as random effects, due to ICC values for Team and Tournament that

were negligent. Athlete was included in the random structure to account for repeated measures of individuals.

6.5 Analysis of study predictions

6.5.1 Prediction 1.a: More positive perceptions of team performance predict higher levels of team click

This prediction was tested by assessing the relationship between perceptions of components of team performance and perceptions of team click in the Post-Tournament and Pre- to Post-Tournament data.⁴

Post-Tournament

Results of the Post-Tournament analysis support this prediction. The model revealed a significant positive effect of Team Performance Components on Team Click ($\beta = .65$ (95%CI = .44, .88), $SE = .11$, $t(13.13) = 5.94$, $p < .01$, marginal $R^2 = .56$, conditional $R^2 = .61$). All other fixed effects did not significantly predict team click, but the inclusion of these fixed effects in the model did significantly improve the overall model fit, as indicated by a comparison of AIC/BIC values between iterations of the model (see Appendix E.4.1 Table E.6).

Model residuals were normally distributed around zero ($W = .97$, $p = .06$), and individual cases had low influence on the model (Cook's Distances all $< .25$, see Appendix E.4.1 Figure E.3). Results of this model support the prediction that more positive perceptions of team performance predict higher feelings of team click (see Figure 6.3).

Pre- to Post-Tournament

Results of the Pre- to Post-Tournament data also supported the prediction. The model revealed a significant positive relationship between Team Performance Components Change and Team Click Change ($\beta = .51$ (95%CI = .29, .72), $SE = .11$, $t(10.80) = 4.63$, $p < .01$, marginal $R^2 = .40$, conditional $R^2 = .47$). No other main effects were significant. Model residuals were normally distributed around zero ($W = .98$, $p = .24$), and individual cases had low influence on the

⁴The Overall Tournament data did not contain consistent measures of components of team performance and so was not analysed in relation to Prediction 1.a.

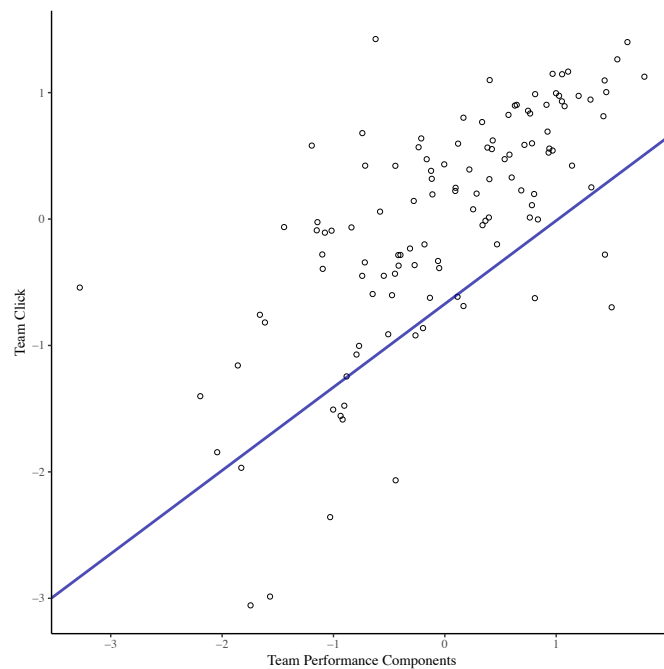


Figure 6.3: Prediction 1.a (Post-Tournament): Team Performance Components predicts Team Click. Both variables are factors expressed as z-scores ($mean \approx 0, SD \approx 1$). The line of best fit has been adjusted based on parameter estimates of the LMER ($n = 98$).

model (Cook's Distances all $< .20$; see Appendix E.4.1 Table E.7 for results of all iterations of the model and Figure E.4 for model assumptions).

This model supported the prediction that positive change in perceptions of components of team performance are associated with increase in feelings of team click (see Figure 6.4). On average, athletes who reported a positive increase in perceptions of components of team performance also reported a positive increase in feelings of team click throughout the Tournament.

In sum, results suggest more positive perceptions of components of team performance were associated with higher levels of perceived team click. A positive increase in perceptions of Team Performance Components predicted a positive increase in feelings of Team Click between Pre- and Post-Tournament surveys, suggesting that athletes who perceived an increase in success of components of team performance also experienced an increase in feelings of team click. Together, these results support a relationship between joint action and team click.

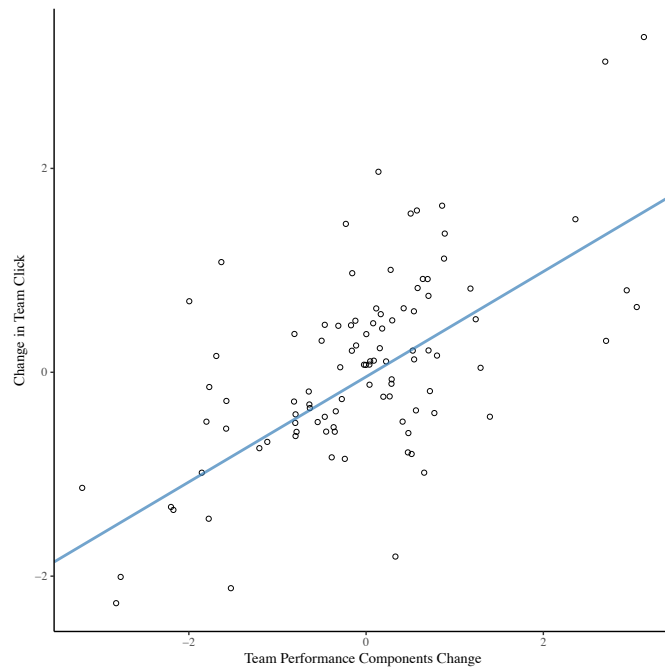


Figure 6.4: Prediction 1.a (Pre- to Post-Tournament): Team Performance Components Change predicts Team Click Change. The slope has been adjusted according to the parameter estimates of the linear model ($n = 97$).

6.5.2 Prediction 1.b: Higher levels of team click will predict higher levels of social bonding

Post-Tournament

Results supported the prediction. A LMER model revealed a significant relationship between Team Click and Social Bonding, $\beta = .64$ ($95\%CI = .47, .81$), $SE = .09$, $t(13.73) = 7.49$, $p < .01$, marginal $R^2 = .49$, conditional $R^2 = .51$ (see Appendix E.4.2 Table E.8 for a full description of results). No other main effects were significant. Model residuals were normally distributed around zero ($W = .98$, $p = .14$), and individual cases had low influence on the model (Cook's Distances all $< .15$, see Appendix E.4.2 Figure E.5 for a full report of model assumptions). The model supported the prediction that higher levels of team click are associated with higher levels of social bonding (see Figure 6.5).

Pre- to Post-Tournament

Results of the Pre- to Post survey data also supported the prediction. The LMER

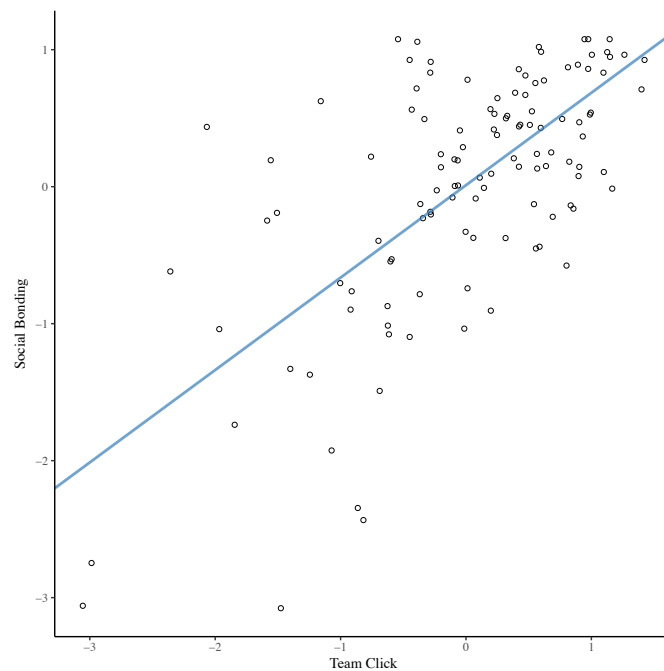


Figure 6.5: Prediction 1.b (Post-Tournament): Team Click predicts Social Bonding. The slope reflects the model parameter estimates of the LMER ($n = 97$).

model revealed a significant positive effect of Team Click Change on Social Bonding Change, ($\beta = .37$ (95% $CI = .10, .64$), $SE = .14$, $t(8.75) = 2.65$, $p = .03$, marginal $R^2 = .17$, conditional $R^2 = .23$; see Appendix E.4.2 Table E.9 for a full description of model estimates). Model residuals were normally distributed around zero ($Shapiro-Wilk = .98$, $p = .15$). and individual cases had low influence on the model (Cook's Distances all $< .6$, see Appendix E.4.2 Figure E.6 for model assumptions). This model suggests that athletes who experienced an increase in feelings of team click also experienced an increase in feelings of social bonding towards their team (see Figure 6.6).

Overall Tournament

A model of the Overall Tournament data also supported the prediction. The LMER revealed a significant positive relationship between Team Click and Social Bonding, $\beta = .64$ (95% $CI = .55, .74$), $SE = .05$, $t(87.4) = 13.84$, $p < .01$, marginal $R^2 = .49$, conditional $R^2 = .66$. No other main effects were significant.

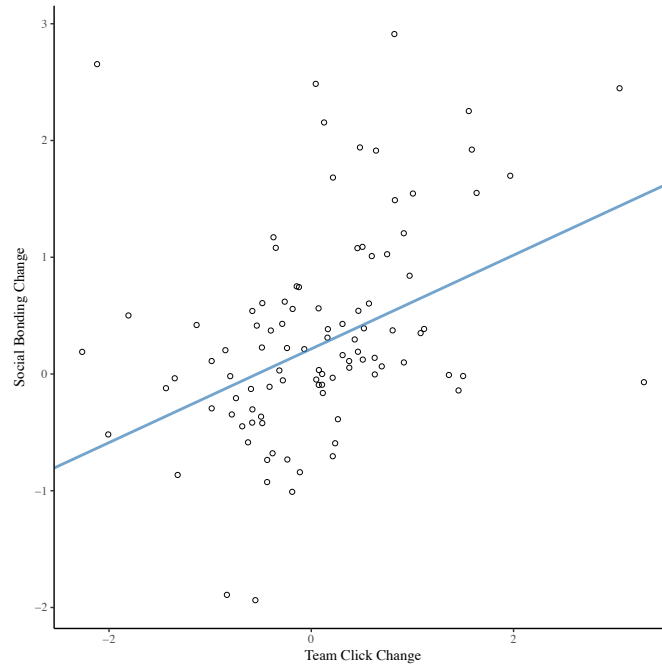


Figure 6.6: Prediction 1.b (Pre- to Post-Tournament): Team Click Change predicts Social Bonding Change. The slope reflects parameter estimates of the LMER ($n = 97$).

Examination of model residuals revealed that they were not normally distributed around zero, ($W = .92, p < .01$), owing to high negative skew (-1.24) and high kurtosis (5.12) (see Appendix E.4.2 Figure E.7). Exclusion of outliers according to Tukey's method (observations above and below $1.5x$ the Inter Quartile Range (IQR); see Tukey, 1977), and log transformation of the outcome variable failed to markedly improve the normality of residuals (Outlier removal: $W = .92, p < .01$, and Log transformation: $W = .96, p < .01$, respectively). To resolve this assumption violation, the outcome variable was first subjected to outlier-removal, and then subsequently log-transformed, which appeared to improve the distribution of residuals only somewhat ($W = .98, p = .0002$). The failure of this model to converge suggested that it was not a robust indication of the relationship between Team Click and Social Bonding in the Overall Tournament data.

In sum, athlete perceptions of team click predicted athlete perceptions of social bonding in the Post-Tournament and Pre- to Post-Tournament data sets. The Overall Tournament model of this relationship was not reliable due to the violation of model assumptions.

6.5.3 Prediction 1.c: More positive perceptions of team performance will predict higher levels of social bonding

Post-Tournament

The model revealed a significant effect of Team Performance Components on Social Bonding, $\beta = .41$ (95%CI = .14, .69), $SE = .14$, $t(21.98) = 2.92$, $p < .01$, marginal $R^2 = .27$, conditional $R^2 = .42$. The model also revealed a significant positive effect of Subjective Competence on Social Bonding, $\beta = .09$ (95%CI = .02, .16), $SE = .03$, $t(90.76) = 2.52$, $p = .01$. No other main effects were significant (see Appendix E.4.3 Table E.10).

Model residuals were non-normally distributed ($W = .95$, $p = .0007$), owing to relatively large negative skew (-.87) (see Appendix E.4.3 Figure E.8). The graphic representation of the data indicated possibility of outliers biasing the model (see Figure 6.7). Exclusion of outliers (based on Tukey's method, see Section 6.5.5) improved the distribution of model residuals, but still violated the assumption of normality ($Shapiro - Wilk = .96$, $p = .009$). Individual cases had low influence on the model (Cook's Distances all $< .10$).

Due to the *positive* skew of the model residuals, the outcome variable was transformed by taking the log of the reversed scores of the outcome variable (i.e., $\log_{10}(k - y)$), where k is a constant value from which each score for y is subtracted so that the distribution of the outcome variable is reversed (Howell, 2012).⁵ Transformed values were then returned to their original direction for analysis (Field et al., 2012). Rebuilding the model with a log-transformed outcome variable appeared to improve the fit of the model more than the outlier-removed model, and avoided the removal of any observations.

This adjustment achieved normal distribution of residuals ($W = .98$, $p = .08$), and the R-squared values for the model improved (marginal $R^2 = .27$, conditional $R^2 = .43$; see Appendix E.4.3 Figure E.10 for model results and assumptions).

⁵Reversing the distribution of the outcome variable allows the logarithmic function to normalise the distribution of the variable, by pushing them from the left hand side of the distribution towards the centre.

Results of the log-transformed model were taken as satisfactory evidence for a significant positive relationship between perceptions of Team Performance Components and feelings of Social Bonding. Results also suggested that on average athletes who reported higher levels of subjective competence also reported higher levels of social bonding.

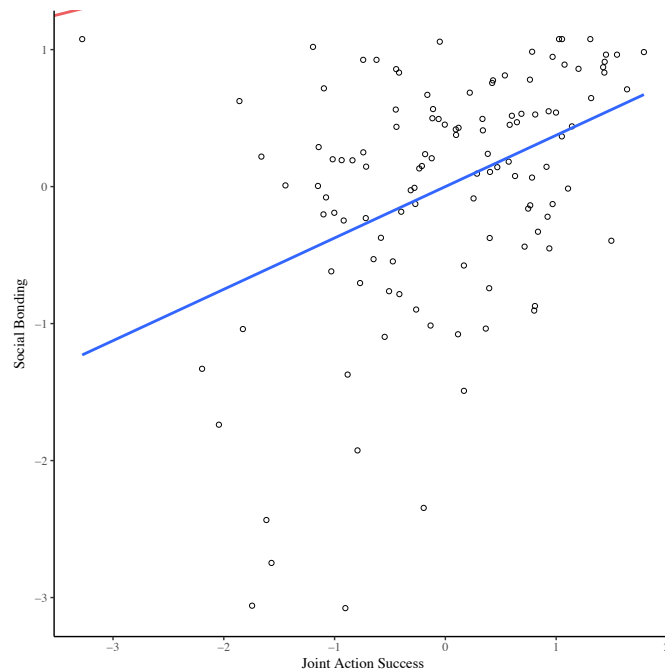


Figure 6.7: Prediction 1.c (Post-Tournament): Team Performance Components predicts Social Bonding. The line of best fit reflects the log-adjusted LMER model ($n = 97$).

Pre- to Post-Tournament

Results of a LMER model revealed a significant positive effect of Team Performance Components Change on Social Bonding Change ($\beta = .36$ ($95\%CI = .19, .54$), $SE = .09$, $t(90) = 4.02$, $p < .01$, marginal $R^2 = .18$, conditional $R^2 = .18$), suggesting that on average, athletes who experienced a positive increase in perceptions of components of team performance also experienced an increase in perceptions of social bonding (see Figure 6.8). All other fixed effects were not significant (see Appendix E.4.3 Table E.11). Model residuals were normally distributed around zero ($W = .98$, $p = .19$), and individual cases had low influence on the model (Cook's Distances all $< .5$; see Appendix E.4.3 Figure E.11 for a full description of model

assumptions). This model supported the prediction that more positive perceptions of components of team performance significantly predict higher levels of social bonding.

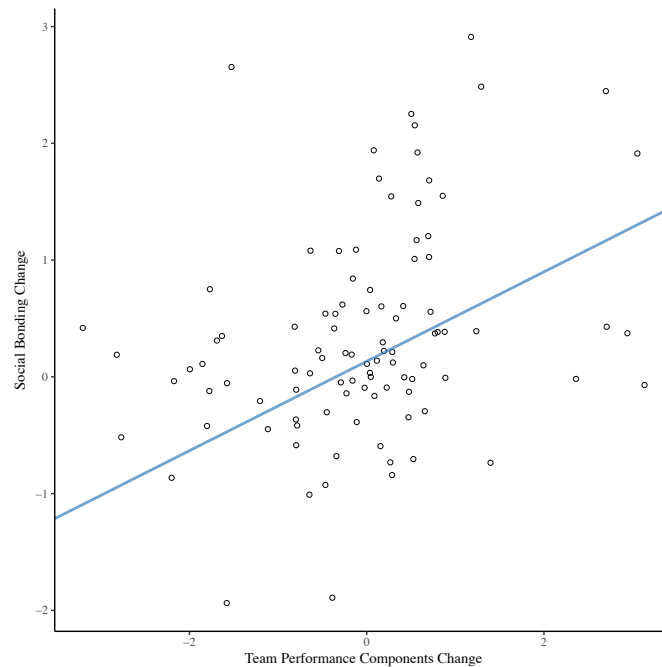


Figure 6.8: Prediction 1.c (Pre- to Post-Tournament): Team Performance Components Change predicts Social Bonding Change. The line of best fit reflects the parameter estimates of the LMER ($n = 97$).

6.5.4 Prediction 1.d: Team click will mediate a relationship between more positive perceptions of team performance and social bonding

Post-Tournament

Results of the mediation analysis revealed significant average indirect effect of Team Performance Components on Social Bonding attributable to Team Click, $\beta = .37$, $95\%CI = .20, .59$, $p < .001$. When controlling for the effect of Team Click on Social Bonding, the average direct effect between Team Performance Components and Social Bonding was no longer significant, $\beta = -.006$, $95\%CI = -.27, .23$, $p = .96$ (see Figure 6.10). The direct effect diminished such that including Team Performance Components in the model produced a total effect that was marginally *smaller* than the indirect effect alone, $\beta = .36$, $95\%CI = .13, .61$, $p = .01$. These results suggest

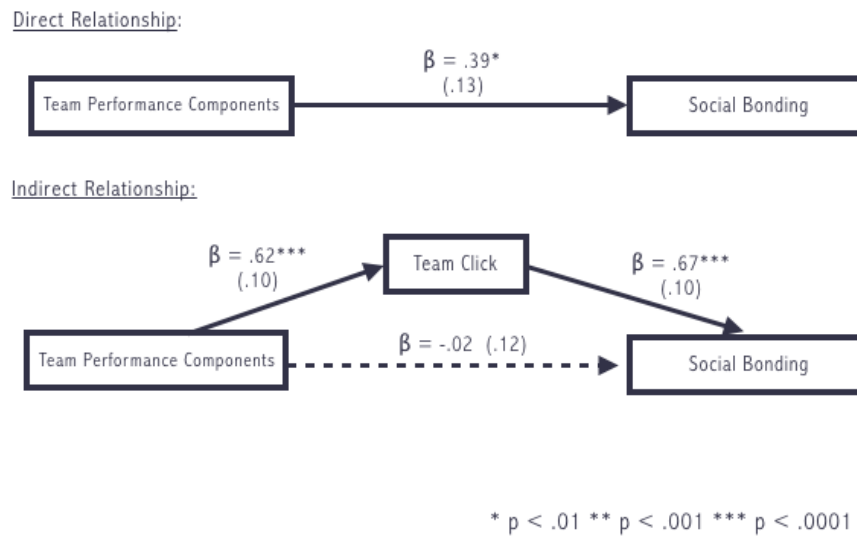


Figure 6.9: Prediction 1.d Mediation Model (Post-Tournament): Team Click fully mediates the relationship between Team Performance Components and Social Bonding ($n = 98$).

that feelings of team click fully mediate the relationship between perceptions of team performance and social bonding.

Pre- to Post-Tournament

Results from the models reported above demonstrate significant relationships between Team Performance Components Change and Team Click Change (Prediction 1.a), and Team Click Change and Social Bonding Change (Prediction 1.b). In addition, a direct relationship between Team Performance Components Change and Social Bonding Change was also significant (Prediction 1.c). Accordingly, a mediation analysis was performed to formally test whether a change in feelings of team click over the course of the Tournament mediated a direct relationship between change in perceptions of team performance and changes in perception of social bonding.

Results of the mediation analysis revealed that the average indirect effect of Team Performance Components Change on Social Bonding Change attributable to

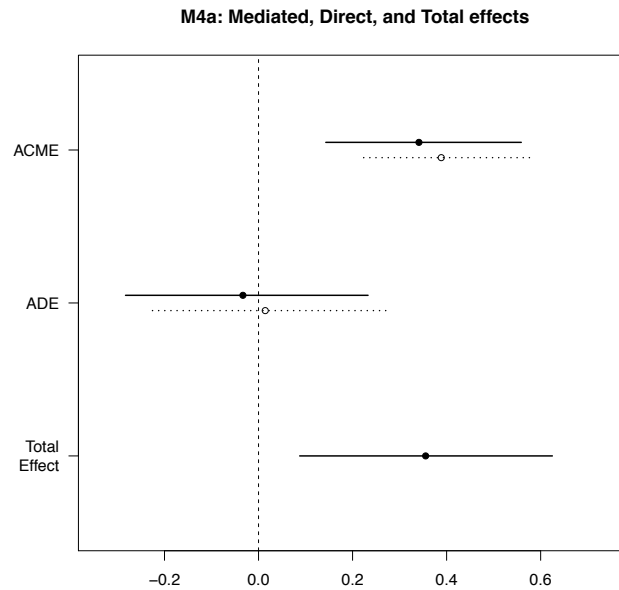


Figure 6.10: Prediction 1.d Mediation Effects (Post-Tournament): Team Click fully mediates the relationship between Team Performance Components and Social Bonding, such that the direct effect (ADE) is no longer significant ($n = 98$)

Team Click Change was not significant, $\beta = .14$, $95\%CI = -.004, .30$, $p = .06$, but trended in the predicted direction (see Figure 6.12). When controlling for the effect of Team Click Change on Social Bonding Change, the average direct effect between Team Performance Components Change and Social Bonding Change was, however, significant, $\beta = .27$, $95\%CI = .07, .48$, $p < .001$. The total effect of the meditation was also significant ($\beta = .41$, $95\%CI = .21, .63$, $p < .001$; see Figure 6.11).

These results suggest a marginally-significant *partial* mediation effect of Team Click Change on the relationship between Team Performance Components Change and Social Bonding Change. This (marginally significant) result offers some support for the indirect effect observed in the Post-Tournament data.

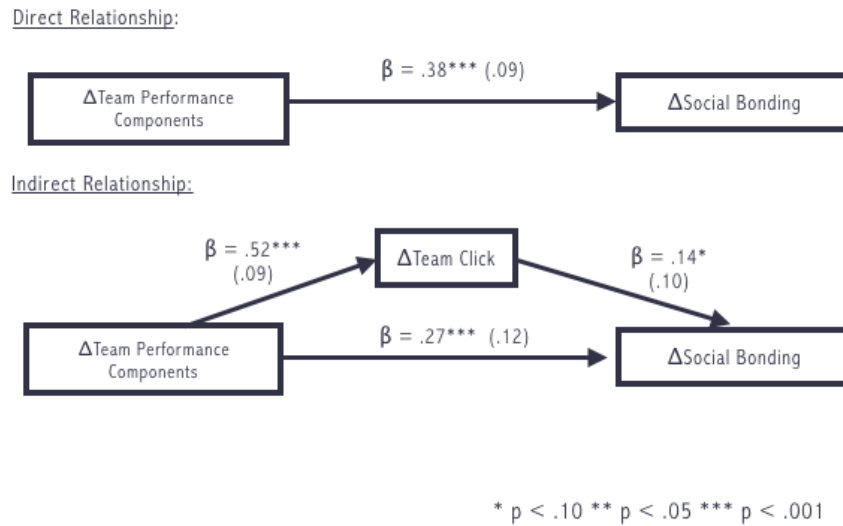


Figure 6.11: Prediction 1.d Mediation Model (Pre- to Post-Tournament): Team Click Change partially mediates the relationship between Team Performance Components Change and Social Bonding Change ($n = 97$).

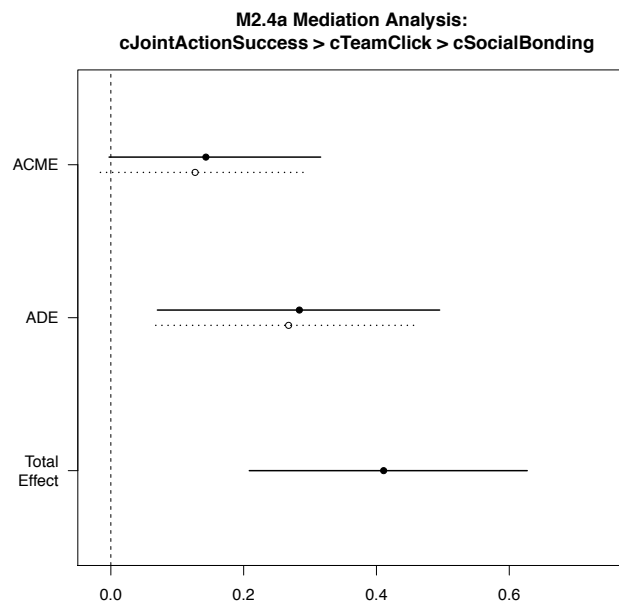


Figure 6.12: Prediction 1.d Mediation Effects (Pre- to Post-Tournament): Team Click Change partially mediates the relationship between Team Performance Components Change and Social Bonding Change, such that the direct effect (ADE) remains significant ($n = 97$).

6.5.5 Prediction 2.a: More positive perceptions of team performance relative to prior expectations will predict higher levels of team click

Post-Tournament

Results of the model revealed a significant positive relationship between Team Performance Vs Expectations and Team Click, $\beta = .52$ (95%CI = .28, .77), $SE = .12$, $t(14.00) = 4.24$, $p < .08$, marginal $R^2 = .40$, conditional $R^2 = .56$. In addition, there was a significant effect of Fatigue ($\beta = .18$ (95%CI = .01, .35), $SE = .08$, $t(91.00) = 2.06$, $p = .04$), and a marginally significant effect of Final Rank ($\beta = .09$ (95%CI = .0005, .18), $SE = .05$, $t(36.34) = 1.97$, $p = .06$). All other fixed effects did not significantly predict Team Click (see Appendix E.4.4 Table E.12 for step-wise iterations of the model).

Model residuals were normally distributed around zero ($W = .98$, $p = .28$), and individual cases had low influence on the model (Cook's Distances all $< .2$, see Appendix E.4.4 Figure E.12). The relationship between Team Performance Vs Expectations and Team Click is represented in Figure 6.13. Results support the prediction that more positive perceptions of team performance relative to prior expectations are associated with higher levels of team click. In addition, results suggested that higher levels of Fatigue, and greater objective performance in the Tournament (Final Rank) also influenced ratings of Team Click.

Pre- to Post-Tournament

The model revealed a significant positive relationship between Team Performance Vs Expectations and Team Click Change ($\beta = .30$ (95%CI = .09, .51), $SE = .10$, $t(16.80) = 2.82$, $p = .01$, marginal $R^2 = .12$, conditional $R^2 = .22$), indicating that athletes who reported more positive violations of expectations concerning their team's performance also reported higher levels of team click. No other main effects were significant. Model residuals were not normally distributed around zero ($W = .96$, $p = .003$), due to positive skew (.85). Log-transformation of the outcome variable did not markedly improve the non-normality of residuals

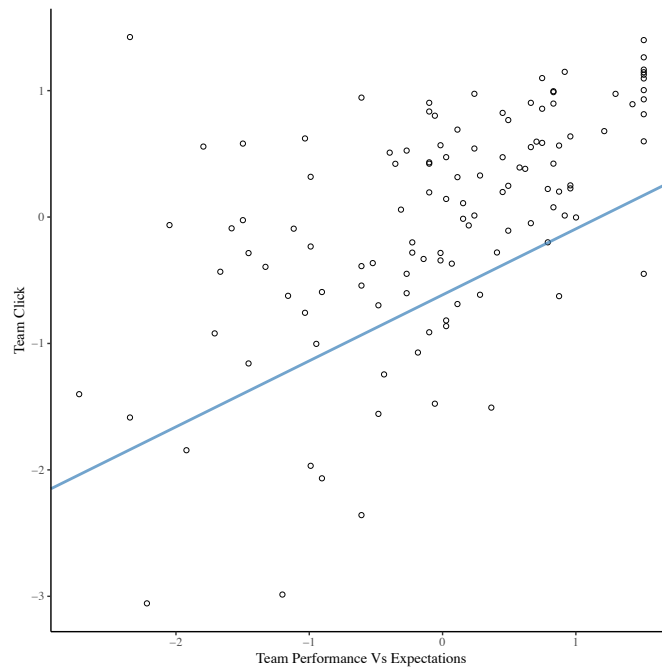


Figure 6.13: Prediction 2.a (Post-Tournament): Team Performance Vs Expectations predicts Team Click. The slope has been adjusted according to the predictions of the linear model ($n = 97$).

(*Shapiro – Wilk* = .96, $p = .008$). Exclusion of outliers according to Tukey’s method improved the model fit such that residuals were normally distributed, (*Shapiro – Wilk* = .99, $p = .89$), and individual cases had low influence on the model (Cook’s Distances all $< .10$, see Appendix E.4.4 Figure E.13).

The adjusted model supported the original significant main effect of Team Performance Vs Expectations on Team Click Change, ($\beta = .36$ (95%*CI* = .16, .55), $SE = .10$, $t(9.78) = 3.66$, $p < .01$, marginal $R^2 = .16$, conditional $R^2 = .55$). The model also revealed a significant *negative* main effect of Individual Performance Vs Expectations on Team Click Change ($\beta = -.22$ (95%*CI* = $-.06, -.38$), $SE = .08$, $t(91.90) = -2.74$, $p = .001$), suggesting that more positive perceptions of individual performance relative to prior expectations predicted decrease in team click over the course of the Tournament. All other main effects of the adjusted model were not significant (see Appendix E.4.4 Table E.13 for a comparison of adjusted models). The slope of the outlier-adjusted model is included in a graphical representation of the relationship (see Figure 6.14).

These results generally confirmed the prediction that, on average, athletes who experienced more positive perceptions of team performance relative to prior expectations following the Tournament experienced more positive increases in Team Click. By contrast, athletes who on average experienced more positive expectation violation in relation to *individual* performance reported less increase in Team Click.

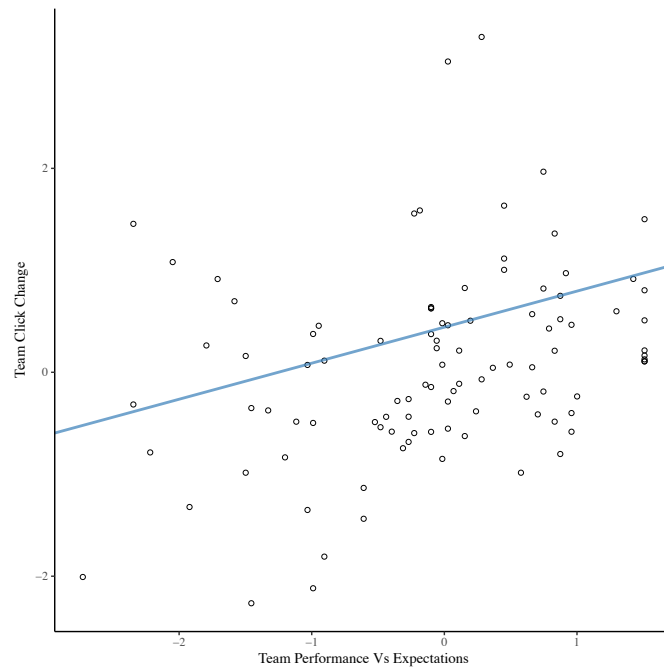


Figure 6.14: Prediction 2.a (Pre- to Post-Tournament): Team Performance Vs Expectations predicts Team Click Change. The slope reflects the parameter estimates of the LMER model ($n = 97$).

Overall Tournament

Analysis of the Overall Tournament subset confirmed the prediction. The model revealed a significant relationship between Team Performance Vs Expectations and Team Click ($\beta = .72$ (95%CI = .62, .80), $SE = .05$, $t(185.29) = 16.06$, $p < .01$, marginal $R^2 = .63$, conditional $R^2 = .69$). The model also indicated that Ind Performance Vs Expectations significantly predicted Team Click, $\beta = .12$ (95%CI = .04, .20), $SE = .04$, $t(294.70) = 2.83$, $p < .01$ (all other main effects were not significant (see Appendix E.4.4 Table E.14 for a full description of results). The relationship between Team Performance Vs Expectations and Team Click is represented graphically in Figure 6.15.

The residuals of the model were normally distributed around zero, ($W = .99, p = .11$), and individual cases had low influence on the model (Cook's Distances all $< .05$; see Appendix E Figure E.14 for a full report of model assumptions). Results of the model suggest that athletes whose expectations around team performance were more positively violated also experienced stronger feelings of team click. The model also revealed main effects of Individual Performance Vs Expectation, which suggests that perceptions of individual performance may also play contribute to producing perceptions of team click.

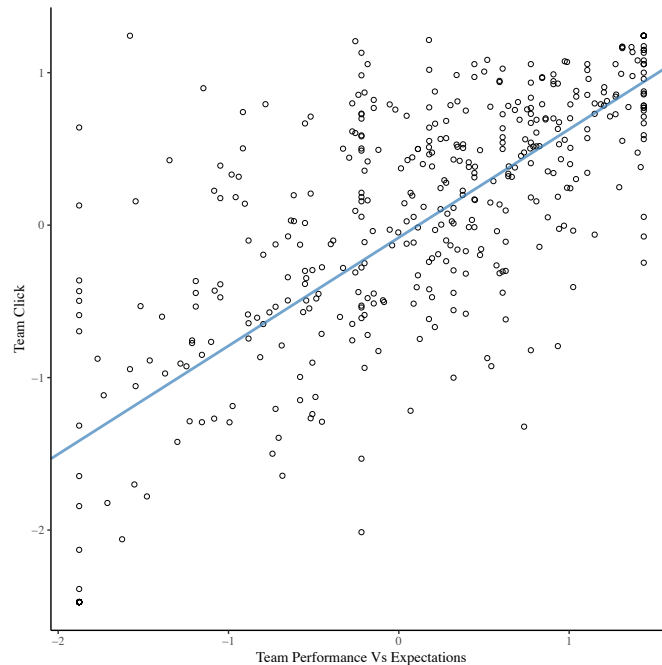


Figure 6.15: Prediction 2.a (Overall Tournament): Team Performance Vs Expectations predicts Team Click. The slope reflects the parameter estimates of the LMER model ($n = 306$).

Results from each subset supported the prediction that more positive expectation violation around team performance is associated with team click. There was some evidence to suggest that more positive violations of expectations concerning individual performance and (self-reported) technical competence may also predict team click (Overall Tournament). Results also showed an opposite effect, whereby higher levels of expectation violation concerning individual performance predicted lower levels of team click (Pre- to Post-Tournament).

6.5.6 Prediction 2.b: More positive violations of team performance expectations predicts higher social bonding

Post-Tournament

The model revealed a significant positive relationship between Team Performance Vs Expectations and Social Bonding, $\beta = .35$ (95%CI = .06, .64), $SE = .14$, $t(12.80) = 2.39$, $p = .03$, marginal $R^2 = .20$, conditional $R^2 = .40$. The model also revealed a significant positive effect of Subjective Competence on Social Bonding, $\beta = .19$ (95%CI = .02, .36), $SE = .08$, $t(90.37) = 2.24$, $p = .03$, such that athletes who provided higher ratings of their own technical competence in rugby (measured before the Tournament) reported higher levels of social bonding.

Model residuals were not normally distributed, ($W = .91$, $p < .01$), owing to large negative skew (-1.33) and high kurtosis (.49). Re-running the model with a log-transformed outcome variable appeared made the best improvement to the distribution of model residuals (compared to an outlier-removed model), but residuals of the log-transformed model were non-normally distributed ($W = .97$, $p = .04$). Owing to non-normally distributed residuals, this model does not provide robust support for the prediction that team performance expectation violations relates directly to social bonding (see Appendix E.4.5 Figures E.15 and E.17 for model assumptions).

Pre- to Post-Tournament

A model revealed a marginally significant main effect of Team Performance Vs Expectations on Social Bonding Change $\beta = .20$ (95%CI = $-.0004$, .02), $SE = .11$, $t(97) = 1.87$, $p = .07$, marginal $R^2 = .05$, conditional $R^2 = .05$. Examination of model residuals revealed that they were not normally distributed around zero ($Shapiro - Wilk = .96$, $p = .008$). Re-running the model with a log-transformed outcome variable and outliers excluded improved the normality of residuals ($Shapiro - Wilk = .98$, $p = .24$). However the effect of Team Performance Vs Expectations on Social Bonding was no longer significant, $\beta = .04$ (95%CI = .02, .10), $SE = .03$, $t(95) = 1.29$, $p = .10$, marginal $R^2 = .03$, conditional $R^2 = .09$.

These results suggest that perceptions of team relative to prior expectations between Pre- and Post-Tournament measurements did not suitably explain observed variation in Social Bonding Change (see Appendix E.4.5 Figure E.17 for model assumptions).

Overall Tournament

The initial model failed to converge with the random slope and intercept model structure. As such, the model was simplified to estimate only the random slope. This simplified model revealed a significant positive relationship between Team Performance Vs Expectations and Social Bonding, $\beta = .47$ (95%CI = .53, .74), $SE = .06$, $t(306.00) = 8.26$, $p < .01$, marginal $R^2 = .40$, conditional $R^2 = .40$. The model also revealed a significant relationship between Individual Performance Vs Expectations and Social Bonding, $\beta = .25$ (95%CI = .002, .009), $SE = .06$, $t(306) = 4.36$, $p < .01$. Model residuals were non-normally distributed, ($W = .97, p < .01$), with negative skew ($-.60$), and higher than normal kurtosis (> 2). A model in which the outcome was log-transformed following removal of outliers provided the best possible fit for the available data (see Appendix E.4.5 Figure E.18). While the distribution of errors was still non-normal following transformation ($W = .99, p = .03$), error terms appeared much more evenly distributed around zero than the original model, albeit with a slight negative skew ($-.10$). The adjusted model was suggestive of a relationship, but was not taken as confirmation for Prediction 2.b, due to irreconcilable violation of model assumptions.

In sum, athlete perceptions of team performance relative to prior expectations did not predict athlete perceptions of social bonding during the Tournament.

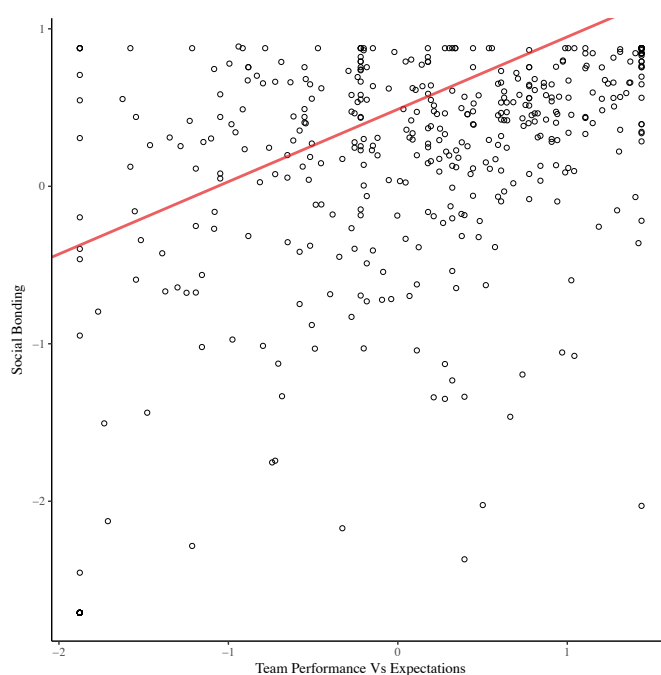


Figure 6.16: Prediction 2.b (Overall Tournament): Team Performance Vs Expectations predict Social Bonding in the data. The line of best fit reflects the parameter estimates of the adjusted LMER model ($n = 271$). *Note: the assumption of normality of residuals was violated and figure is presented for reference only.*

6.6 Discussion

The results of this study suggest that team click mediates a relationship between joint action and social bonding in group exercise. This relationship was substantiated by findings that, in a high-stakes national rugby tournament in which levels of uncertainty in joint action were assumed to be high, athletes who reported more positive perceptions of team performance were more likely to perceive higher levels of team click (Prediction 1.a), and athletes who perceived higher levels of click in joint action perceived higher levels of social bonding (Prediction 1b). A multi-level mediation analysis using the Post-Tournament data set showed that the significant direct relationship between perceptions of Team Performance Components and Social Bonding (Prediction 1.c) was fully mediated by Team Click. In addition, a marginally significant partial mediation was shown in the Pre- to Post-Tournament data set. These results represent the first empirical substantiation of a general theory of team click in a real-world group exercise setting.

Results also suggested that positive violations of expectations surrounding team performance may be an important precedent for the visceral and socially agentic experiences associated with team click (Prediction 2.a). Results did not support the predicted direct relationship between expectation violation and social bonding (Prediction 2.b), which indicated that while expectation violation in joint action might be an important factor in drawing attention to visceral and socially agentic perceptions of team click (Chetverikov, 2014), it might not be a strong enough mechanism to directly drive associations between these perceptions and more elaborate processes characteristic of social bonding, such as perceived emotional support and common goal with teammates. This result indicated the need for further analysis of positive expectation violation in a controlled experimental setting.

In addition to predicted main effects, models on occasion revealed significant effects of moderator variables of interest. Fatigue positively predicted variation in Team Click (in a model of the relationship between Team Performance Vs Expectations and Team Click using the Post Tournament data; Prediction 2.a). Ethnographic evidence suggested that fatigue may have had a *negative* impact

on athletes' ability to mitigate the uncertainties of on-field joint action. Under fatigue, athletes reported a lack of on-field awareness (*yishi*), which, contrary to results reported here, could suggest that fatigue has a negative impact on perceptions of team click.

However, research has proposed that physiological exertion in exercise could also be associated with experiences of euphoria (e.g., “flow” and the “runner’s high”) owing to down-regulation of cortical processes (Dietrich & Audiffren, 2011), and exercise-specific neuropharmacological reward (Raichlen et al., 2013). Dietrich and colleagues propose that cortical structures implicated in decision-making and self-monitoring could at times be detrimental to achieving dynamical coordination in action due to their belonging to a subsystem of cognitive function (i.e., a deliberate “system 2” as opposed to more automatic and implicit “system 1”; see Kahneman, 2011) characterised by slower and more deliberate executive function, rather than in-the-moment movement control. By contrast, viewed from the perspective of the AIF, fatigue-related strain on cognitive processes would likely reduce the reliability (precision-weighting) of (more uncertain/less reliable) exteroceptive inputs, favouring instead the more proximate and reliably interoceptive information (Pezzulo, 2014). Thus, these results could be interpreted as being commensurate with the claim advanced in this thesis, that the visceral experience of team click is generated in environments in which interoceptive information is the most reliable available source for inference.

In the same model, the objective performance measure of Final Rank also predicted variation in team click. This result was theoretically expected: better performing teams would necessarily achieve higher levels of coordination in response to higher levels of uncertainty in joint action. However, this result also signalled a methodological limitation. In a high-stakes Tournament, athletes are provided with explicit feedback about joint action, in the form of winning and losing each game, scoring points, or feedback from coaches. Although some of these factors were addressed through statistical controls, it could be expected that more explicit and external information available in the environment would have informed athlete

perceptions of team performance, team click, and social bonding. From a theoretical perspective (i.e., based on claims of the AIF), it was possible that athlete perceptions of team click were influenced by affordances less grounded in individual sensorimotor experiences, and instead more contingent socially- (rather than sensorily-) mediated sources of information (Ramstead et al., 2016). Thus, this result represented a potential problematic confound to the proposed causal relationship between joint action, team click, and social bonding. In essence, athletes may have reported higher levels of team click because they thought they ought to report such perceptions as a member of a better performing team. As I discuss below, this issue should be addressed through controlled experimental design.

The results of this study showed that, in general, perceptions of team performance (relative to perceptions of individual performance) were more powerful as predictors of team click and social bonding. However, on two occasions athlete perceptions of individual performance relative to prior expectations predicted variance in team click. These results were conflicting and thus difficult to interpret. In the Pre- to Post- Tournament analysis, a log-adjusted model revealed a *negative* main effect of Individual Performance Vs Expectations on Team Click (see Section 6.5.5), which suggested that individuals who felt higher levels of positive expectation violation concerning individual performance perceived lower levels of team click (measured as a function of change between Pre- and Post-Tournament surveys). Meanwhile, the Overall Tournament analysis revealed an opposite effect: a significant positive relationship between Individual Performance Vs Expectations and Team Click (see Overall Tournament results in Section 6.5.5). This result suggested that athletes who experienced more positive violations concerning individual performance also reported higher levels of team click.

Considered together, these results could suggest the co-presence of two opposing modes of joint action evaluation (Friston & Frith, 2015b), one in which individuals tend to perceive more positive violations of individual performance expectations as distinct from team click, and a mode in which more positive violations of expectations surrounding individual performance may enhance perceptions of team performance.

It is possible to imagine real-world scenarios in which athletes feel satisfied or surprised about their individual contributions to joint action, but nonetheless do not perceive that the team clicked. Consider Beijing senior player Lu Peng, for example, who was often critical of team performance and avoided admission of individual deficiencies. Likewise, it is also imaginable that more positive perceptions of individual performance relative to expectations could have an additive effect on experience of team click and social bonding. Dynamic interactive joint action can involve a blurring of boundaries between self and others and, thus cognitions and perceptions attributed to individual performance and team performance could share common variance (Friston & Frith, 2015a). These results could be interpreted as suggesting that the “we-mode” of cognition characteristic of team click also contains a strong “I-mode” as its sensorimotor foundation (Gallotti & Frith, 2013; van der Wel, 2015). Variation in the differential recruitment of these modes could be explained by individual variation in tendencies for movement in joint action (Keller et al., 2014).

Subjective and objective measures of technical competence were included in analyses based on theoretical and ethnographic evidence to suggest that familiarity with technical components of joint action may condition the relationship between perceptions of joint action, team click, and social bonding. In this study, there was no clear evidence that Objective Competence (training age, years in team, age) significantly altered predicted relationships of interest. Subjective Competence significantly predicted Social Bonding in one model (prediction 1.c), but these results were not consistent in relationships between all variables of interest.

It is possible that these measures failed to access the (largely pre-perceptual) mechanisms of prediction error management hypothesised to underpin cognition and affective dispositions in joint action (Clark, 2013). It is also possible that the nature of the intensity and consequentiality of the Tournament in which athletes were participating was high enough that no one—experts athletes included—was immune to the uncertainty and of joint action. Indeed, the ability of competitive group exercise contests to consistently arouse high levels of psychological stress and

uncertainty could be an important reason for their cultural evolutionary success over recent centuries (Dunbar & Shultz, 2010; Whitehouse, 2004).

Self-reported measures of technical competence (Subjective Competence—ability relative to teammates, Chinese opponents, or international professionals)—did significantly predict Team Click (when included as a control variable in a model of the relationship between Team Performance Vs Expectations and Team Click in the Overall Tournament data, Prediction 2.a), and Social Bonding (in a model of the direct relationship between Team Performance Components and Social Bonding in the Post-Tournament data, Prediction 1.c). These results suggested that more technically competent athletes (according to subjective self report) may have experienced higher levels of team click and social bonding, owing to more precise ability to achieve dynamical coordination in joint action, and therefore experience the visceral and socially agentic experiences associated with this achievement in instances in which joint action was successful. It was possible that athletes who were willing to self-report higher levels of technical competence may also have been more willing to report higher levels of other desirable variables such as team click and social bonding. Thus, these results should be treated with caution.

In addition to technical competence, a measure of extraversion was included in models to control for the possibility that preexisting dispositional tendencies could impact on processes of team click and social bonding (Marsh et al., 2009; von Rueden, Gavrillets, & Glowacki, 2015). In particular, it is believed that extraversion may be associated with a propensity to seek out opportunities for coordination (Richardson, Marsh, & Baron, 2007), and to attribute agency in these interactions to sources beyond the self (also known as external locus of control; see Morris & Carden, 1981). For example, Richardson et al. (2007) found that extraversion positively correlated with willingness to sustain cooperation in joint action in a dyadic plank moving task. In the present study, results revealed no significant effects of extraversion on variables of interest.

The uncontrolled and *in-situ* design of this study posed many challenges to causal inference. To address this issue, theoretically motivated predictions were

tested using 3 subsets of data, which included multiple observations per individual athlete, thus increasing the amount and reliability of evidence with which to assess study predictions. In addition, linear mixed-effects regression models allowed for clustering of observations (according to individual or team) could be factored into account. Nonetheless, results should be treated as preliminary and suggestive only.

Hypotheses pertaining to a general account of team click in group exercise thus require further attention via a controlled experimental designs. An experiment in which perceptions of team performance and expectation violation were manipulated as a function of uncertainty, and explicit feedback around performance was eliminated, could allow for the assessment of the role of the cognitive processes of movement coordination in joint action in generating team click and social bonding. These considerations were factored into the design of experimental study, which is presented in the next chapter.

7

Training Experiment

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7.1 Introduction

The perception of click in social interaction is commonplace and not limited to group exercise contexts such as sport, music, or dance. Even interactions in sedentary work place contexts can be the site of click, chemistry, and connection between co-workers. But do these day-to-day activities reliably generate the visceral and socially agentic perceptions of joint action that are characteristic of team click? The dynamical theory of social cognition adopted in this thesis suggests that team click in group exercise may be uniquely defined by high levels of informational uncertainty and social bonding when coordination in joint action is perceived to be successful.

Findings from the the National Tournament study (Chapter 6) found that team click mediated a positive relationship between perceptions of team performance and social bonding in a real-world joint action setting in which uncertainty was assumed to be high. This study sought to manipulate uncertainty in a rugby training drill to examine the effects of uncertainty on athlete expectation violation in team performance, perceptions of team click, and social bonding.

It was hypothesised that higher levels of uncertainty in joint action would generate lower expectations for success in team performance (H2a), and that, in turn, more positive perceptions of team performance relative to prior expectations would lead to higher levels of team click, assuming that levels of success in the training drill would be more or less constant (H2b). In addition, it was expected that more positive violations of expectations concerning team performance would set the foundation for higher levels of social bonding.

The Invasion Drill

A between-subjects experimental design was used, in which athletes participated in a typically encountered rugby training drill known as the “Invasion Drill” (Passos et al., 2011). The Invasion Drill emulated a sub-phase of attack and defence in rugby. The training drill was preceded by one of two experimental primes designed to manipulate athlete expectations of uncertainty concerning joint action. In the “high difficulty” condition, athletes were primed to believe that they would be assessed on their ability to perform a technically challenging training drill; athletes in the “low difficulty” condition were primed to believe that they would be assessed on their ability to perform a technically straightforward rugby training drill. In fact, all athletes performed the exact same drill, only the prime differed between groups.

The experimental manipulation was designed to encourage athletes in the high difficulty condition to generate lower expectations for successful team performance in joint action than athletes in the low difficulty condition. Assuming that actual performance in the subsequent training drill would be constant (the drill was pre-rated by another group of athletes as a moderate difficulty drill), it was predicted that athletes in the high difficulty drill should on average formulate lower expectations concerning success in team performance, as well as experience more positive violations of expectations than athletes in the low difficulty drill. As with the previous study, this study also sought to confirm the role of positive expectation violation in generating team click (H2b). In addition, it was predicted that higher perceptions of success in team performance relative to expectations would generate higher levels of social bonding, to the immediate training group, as well as the provincial team as a whole

Design features of this study aimed to encourage athletes to consult their personal perceptions of team performance. Overt feedback concerning performance was restricted to athletes’ perceptions of each phase of the Invasion Drill. There were no explicit winners or losers, or immediately obvious benefits or costs to incur through participation. The drill required only moderate levels of physiological exertion, and physical contact between athletes in the Invasion Drill was limited to

“grab” as opposed to full-contact. Thus, in contrast to the National Tournament study, this study sought to control many extraneous factors that could impact on athletes’ perceptions of joint action (see Chapter 4.4.2).

Survey measures

Athletes were surveyed at 3 time points: once prior to the test day to collect baseline measures, once immediately before, and once immediately after the training drill. Survey measures were designed to assess athletes’ perceptions of uncertainty in joint action (measured by confidence in team and self to meet the technical challenges in the impending training drill). To check the effectiveness of the experimental manipulation, athletes were asked to report confidence in their own and their group’s ability to meet the technical challenges of the impending training drill. It was expected that athletes in the high difficulty condition would be less confident about their own and their group’s ability to meet the technical challenges of the training session.

Employing a similar rationale to the survey study (see Chapter 6.1), team and individual performance were delineated as separate variables to isolate athlete perceptions of team performance relative to expectation violations. In the pre- and post-drill surveys, athlete were asked to report perceptions of team performance with the specific training group with whom they completed the drill.

Team click was measured using the same collection of items described in the previous chapter (see Chapter 6.2.3.1). In the pre- and post-drill surveys, athlete were asked to report perceptions of team click with the specific training group with whom they completed the drill. Social bonding was also measured using the same items described in the previous chapter (see Chapter 6.2.3.1). In addition to perceptions of social bonding to the specific training group measured pre- and post-drill, athletes were also asked (at baseline and post-drill) about their perceptions of social bonding to the provincial team as a whole. The inclusion of this measure offered the opportunity to test whether team click experienced with a small group of teammates had implications for more generalised perceptions of social bonding to

the group as a whole (see, for example Reddish, Bulbulia, & Fischer, 2013; Swann, Gómez, Dovidio, et al., 2010). In essence, the proposal advanced in this thesis—that team click serves as a template for identification with higher-level representations such as group identity (H1.b)—could be more directly tested.

Together, these items were designed to operationalise hypothesised relationships between uncertainty in joint action, expectations and violations of expectations concerning perceptions of team performance (relative to prior expectations), team click, and social bonding. In addition to these items, measures of technical competence and personality type were collected at baseline, and arousal and injury status were recorded before and after the drill. Objective measures of performance in joint action were derived from video footage. Two subsets of the collected data (Post-Tournament, Pre- to Post-Tournament) were analysed for relationships between variables of interest within individuals and over time. Clustering of responses according to groupings such as experimental session, provincial team, and was assessed and controlled for statistically.

Specifically, this study tested the predictions outlined in Table 7.1. In essence, this study tested the claim that when higher levels of uncertainty in joint action (e.g., when athletes coordinate in complex joint action “under invasion”), they will feel the click of social connection when performance pans out better than originally expected.

Table 7.1: Training Experiment Predictions

Predictions: Training Experiment	
1	Higher levels of uncertainty in joint action will generate: <i>1.a Lower confidence for success of team performance joint action, and</i> <i>1.b More positive perceptions of team performance relative to prior expectations</i>
2	More positive perceptions of team performance relative to prior expectations will predict higher levels of team click
3	Higher levels of team click will predict higher levels of social bonding (to the group or provincial team)
4	More positive perceptions of team performance relative to prior expectations will predict higher levels of social bonding (to the group and provincial team)
5	Team click will mediate a relationship between more positive perceptions of team performance relative to prior expectations and social bonding (to the group and provincial team)

7.2 Method

7.2.1 Participants

64 professional Chinese rugby players were recruited for the study ($M(age) = 21.33, SD = 3.33, range = 16 - 29, men = 32$). Athletes were recruited from two provincial rugby programs, 32 participants were athletes from Shandong province ($M(age) = 22.1, SD = 2.32, men = 15$) and the remaining 32 athletes were from Beijing province ($M(age) = 20.4, SD = 3.11, men = 16$). This study was approved by the University of Oxford's Central University Research Ethics Committee (SAME/CUREC1A/15-059).

7.2.2 Materials

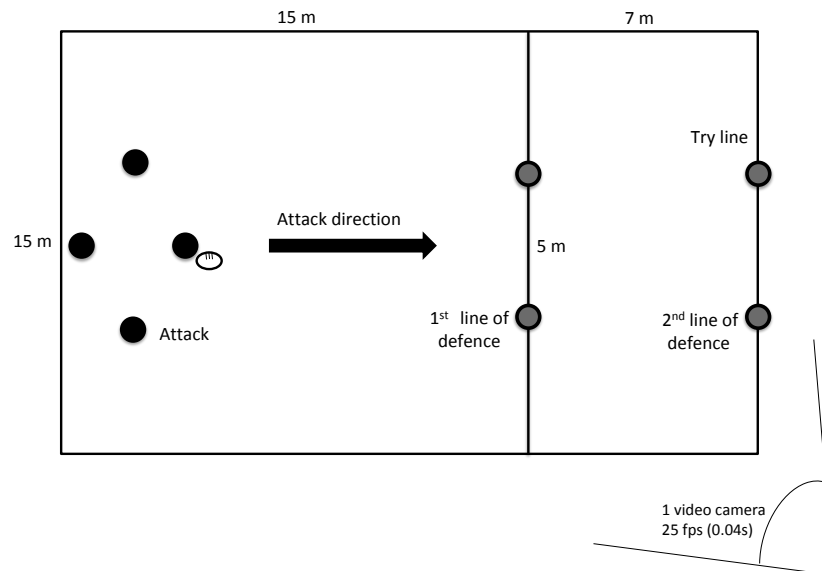


Figure 7.1: The Invasion Drill: a common training drill for rugby union in which a group of 4 attackers attempt to penetrate two consecutive lines of defence. Adapted from Passos (2011).

7.2.2.1 Experimental Paradigm: The Invasion Drill

This study required athletes to participate in a rugby training drill—known as “Invasion Drill” (Biscombe & Drewett, 1998)—which was preceded by one of two experimental primes: a “high difficulty” condition, or a “low difficulty” condition. This training drill was selected as it was representative of a typical subphase of joint action in rugby union and it has been successfully used to measure dynamic coupling between rugby players in joint action (see Passos et al., 2011). In this drill, a group of 4 rugby players form an attacking group and two pairs of opponents form a first and second defensive line. The drill had two performance aims: (a) attackers were asked to carry the ball into the try area, and (b) defenders were asked to stop the progression of attack toward the try line. One trial consisted of one attempt by the attacking sub-group to penetrate two defending sub-groups, and carry the ball over the try line. The drill was conducted on a regulation multipurpose 110m x 70m grass or artificial turf training field within a 22m x 15m rectangle area marked by plastic cones (see Figure 7.1). The ball used was size 5, as recommended by World Rugby for this age group of athletes.¹

7.2.2.2 Experimental Conditions: high and low difficulty

Two different experiment primes were developed to manipulate athletes’ expectations around the technical difficulty of the impending joint action task. Athletes in the “high difficulty” condition learned that the overall average difficulty rating for the training drill, provided by World Rugby coaches and athletes, was 77.5/100, or approximately 8 out of 10. Athletes were told that the drill would require an extension of their abilities as individuals and as a training group. By contrast, athletes in the “low difficulty” condition learned that they would be participating in an ostensibly different drill with an overall average difficulty rating of 22.5/100, or approximately 2 out of 10 (see Appendix F.1.1 for full script). In reality, the

¹During my time conducting research and coaching in China, I did not commonly witness the Invasion Drill as described herein in training scenarios. As such, I judged that the Invasion Drill would be suitable for this experiment because the technical requirements of the drill were be suitably familiar to athletes (i.e., a typical subphase of joint action in rugby), but the drill itself would be suitably novel.

training drill was exactly the same for all experimental sessions. Based on a pilot study with 20 athletes from the Beijing men's and women's rugby programs who did not participate in the study, the actual difficulty of this drill was estimated to be approximately 5/10 (see Appendix F.1.2 for full explanation of pilot study). The experiment primes were designed to encourage athletes to either over or under rate the difficulty of the impending training drill. If successful, the prime would alter athletes' expectations around certainty of performance, such that athletes in the high difficulty condition would enter the training drill with expectations for performance that were on average lower than athletes in the low difficulty prime. It was predicted that athletes in the high difficulty condition would experience more positive perceptions of team performance relative to prior expectations, as compared to athletes in the low difficulty condition, who would on average experience less positive violations of expectations around team performance.

7.2.2.3 Measures

Surveys

Surveys were administered at 3 time points: Baseline (approximately 24 hours before the experiment), Pre-Drill (immediately before the training drill and after receiving the experiment prime), and Post-Drill (immediately following the completion of the drill; see Table 7.2). Consistent with the previous study (Chapter 6), athletes responded to questions about 1) *performance* (including perceptions of individual and team performance relative to prior expectations, and perceptions of components of individual and team performance), 2) *team click* (feelings associated with team click in joint action), and (3) *social bonding* (perceptions of social bonding and group membership). Additionally, athletes responded to questions designed to measure *moderator variables* such as technical competence, personality type, injury status, arousal, and fatigue. Measures of athlete confidence in group and self to meet the technical challenges of the Drill would be used to check the experimental manipulation, and in so doing test Prediction 1.a and 1.b (see Section 7.3.4).

Surveys were designed and administered using Qualtrics software (Qualtrics version 9, Provo, UT). The surveys (initially designed in English) were translated into modern Chinese by the researcher and back translated by two independent native Chinese speaking translators from Beijing Sports University to verify accuracy. Athletes completed the modern Chinese version of each survey using WeChat on their personal mobile devices connected remotely to the internet. Survey data were processed and analysed using the R environment (R Development Core Team, 2006).

Baseline

Baseline measures were obtained 24 hours before the start of the experiment by asking athletes about their impressions of recent individual performance and the performance of their provincial squad as a whole. Survey items included questions relating to specific components of team and individual performance (e.g., team components: attack, defence, on-field communication, and support play; individual components: passing technique, one-on-one tackling, effectiveness in contact areas), as well as items relating to overall impressions of performance, for example: “How well do you feel your team has been performing in training and competition over the past month?” (100 point scale, 0 = “Extremely bad”, 100 = “Extremely good”). Athletes also responded to questions about perceptions of team click and social bonding with their team as a whole. In addition, the Baseline survey also included items concerning basic personal information, current injury status, subjective and objective measures of technical competence, and personality type. For a full explanation of the Baseline survey, see Appendix F.1.4.1.

Pre-Drill

Immediately before each experiment session, athletes were asked questions about feelings and expectations concerning their individual performance and the performance of their specific training group in the impending training drill. For example, athletes were asked “How do you feel *right now* about your individual performance” (100 point scale, 0 = “Extremely bad”, 100 = “Extremely good”). Athletes also responded to items asking about confidence in self and the training group to meet

Table 7.2: Survey items measured at Baseline, Pre-Drill, and Post-Drill.

Items	Baseline	Pre-Drill	Post-Drill
Training Group			
Confidence in group to meet technical challenges		✓	
Group performance vs prior expectations			✓
Components of performance		✓	✓
Team Click		✓	✓
Social Bonding		✓	✓
Individual			
Confidence in self to meet technical challenges		✓	
Individual performance vs prior expectations			✓
Components of individual performance	✓	✓	✓
Team (Province)			
Team Performance	✓		✓
Team Click	✓		✓
Social Bonding	✓		✓
Moderators			
Arousal		✓	✓
Exertion			✓
Injury		✓	✓
Personality	✓		
Technical competence	✓		

the technical challenges of the drill, i.e. “How confidence are you in your own / your training group’s ability to meet the technical challenges of the upcoming drill” (100 point scale, 0 = “Not at all confident”, 100 = “Extremely confident”).

Athletes were also asked a series of questions about perceptions of team click and social bonding to their specific training group. For team click, for example, athletes were asked questions like: “How do you feel the tacit understanding is between the training group today?” (100 point scale, 0 = “Extremely bad”, 100 = “Extremely good”). For social bonding, athletes were asked questions like: “How emotionally supportive does your training group feel right now?” (100 point scale, 0 = “Extremely weak”, 100 = “Extremely strong”).

Post-Drill

Immediately upon completion of the drill, athletes responded to questions concerning their impression of their individual performance and the performance of their training group in the training drill. A single item measure asked about individual and team performance relative to prior expectations: “Overall, how do you feel about your training group’s performance in training today?” (100 point scale, 0 = “Much worse than expected”, 100 = “Much better than expected”). Athletes were also asked about their feelings about team click and social bonding to the training group.

In addition, athletes were asked to answer survey items designed to measure social bonding to the provincial team as a whole (these team-focussed questions replicated the survey items that were asked one day earlier at Baseline). See Appendix F.1.4.2 for an outline of the Post-Drill survey.

7.2.2.4 Video analysis of training team performance in training drill

To produce quantitative measures of successful team performance, athletes’ motion was captured by a single digital video camera (Sony FDR-AX700 4K HDR Camcorder) mounted on a 1.2m high tripod.

The digital camera and tripod were positioned on a platform 2m above the level of the playing field, approximately 10-15m from the bottom try-line corner of the Invasion Drill perimeter (see Figure 7.1). The experimenter began video recording

before the athletes arrived, and ceased recording after all athletes had left the training field following the training drill. Digital video images of action were acquired by a computer and files were saved on an encrypted external hard disk in .AVI format.

Video footage from all 8 experiment sessions was analysed by the researcher as well as an hypothesis blind research assistant familiar with the sport of rugby. Each experimental trial of the Invasion Drill (16 in total) was coded according to success of the group in the primary (attacking) goal of the drill, i.e., scoring a try by carrying the ball over the try line. Two measures were constructed: a binary try or no try (“Try”; 1 = “try”, 0 = “no try”) measure, and a measure designed to reflect the quality of the outcome of each trial (“Trial Outcome”). For this second and more fine-grained measure, a maximum value of 6 was awarded to a “clear try” (trials in which a clear unobstructed try was scored by the attacking sub-unit); 5 to a “rough try” (the ball-carrier crossed the try-line following some minimal level of physical contact or obstruction from the defence that did not halt the momentum of the attacking phase); 4 to an “obstructed try” (a trial in which a try is scored, but the momentum of the attacking sub-unit was clearly interrupted); 3 to a “no try - defence” (a trial in which a ball carrier is completely obstructed by a defender, and the trial is unsuccessful largely due to the effectiveness of the defence); 2 to a “no try - defence forced error” (unsuccessful trial due to a combination of the defence and error in attack); 1 to a “no try - unforced error” (a failed trial due to an unforced error in attack, such as an athlete passing the ball forward, or dropping the ball without obvious pressure from the defence). For each experiment session of 16 trials, the total number of successful trials was calculated (“Tries Total”), as well as the average quality of performance outcome (“Trial Outcome Average”).

The researcher briefed the hypothesis blind research assistant using 10 trials randomly selected from the warm-up trials of each experiment session. Owing to this detailed briefing and the research assistant’s familiarity with rugby, inter-rater reliability, measured using Cohen’s (1960) kappa (suitable for two coders, see Di Eugenio & Glass, 2004) was high for both the Tries Total ($\kappa = .98, Z(128) =$

12.60, $p < .001$) and Trial Outcome ($\kappa = .96$, $Z(128) = 19.96$, $p < .001$), suggesting almost perfect agreement.

7.2.3 Procedure

Permission to run the study was sought from the head coach of each of the 4 teams (Beijing men's, Beijing women's, Shandong men's, Shandong women's). These coaches nominated athletes who were fit and able to complete the session without compromising their existing training schedules. Athletes were randomly assigned to one of two conditions, and then to a particular experimental group, with some subsequent adjustments to assignments to ensure that each condition was matched as much as possible according to average training age. Once athletes were assigned to an experiment group, they were then added to a WeChat group populated by other training group members and the researcher.

Cover Story

Athletes were notified (first via WeChat and then in a team meeting) that they were due to participate in a trial of a various rugby training drills selected from a recent World Rugby report on training methods for rugby sevens. Athletes were told that the training drills had been previously rated by a selection of international level coaches and players from all over the world (including Asia and China). Athletes were informed that the purpose of the exercise was to assess the ratings provided by World Rugby (the international governing body of rugby union) by replicating these drills with more rugby athletes in China. Athletes were told that survey measures and video footage would be collected, which would later be used by the researcher to analyse individual performance of athletes in each training drill.

Baseline survey

Approximately 24 hours before the experiment session, athletes were instructed to complete the baseline survey by opening a link provided in the WeChat group. This survey included formal consent for the study. Approximately 1 hour before the experiment was due to take place, athletes received a notification in WeChat

including information about the projected difficulty of their impending drill session (the experimental prime, for either the “high difficulty” or “low difficulty” conditions (see Section 7.2.2.2 for detailed descriptions). All athletes were lead to believe that athletes in the other experiment groups were performing different drills to their assigned drill. In reality, the training drill for each condition was identical, the only thing that varied was the prime administered before the drill.

Pre-Drill survey

Once the 8 athletes participating in the experiment session were all assembled at the designated training field, the researcher verbally re-administered the same prime that had been sent earlier to the athletes via WeChat, and athletes were told in more detail about the requirements of the Invasion Drill. For example, athletes learned that they would be assessed based on their performance in attack, defence, and their ability to coordinate attack and defence with others (to be assessed through subsequent video analysis). Athletes were provided with no other explicit information regarding performance goals, besides completing the drill to the best of their ability within the rules of rugby.

Athletes were then given the Pre-Drill survey, which took approximately 4 minutes to complete. After all the athletes finished the survey, they participated in a standard warm up routine lasting approximately 10 minutes, including slow jogging and dynamic stretching. Athletes were instructed not to use the rugby ball during this period, which served to reduce the amount of incidental coordination and interaction between participants prior to the start of the experiment trials. Following the warm up, the group assembled in the training drill area. One athlete was randomly assigned to stand at each of 8 available plastic markers. In this position, athletes were told once more about the structure and procedure for the training drill, in particular the way in which athletes were expected to rotate clockwise after every trial of the drill so that athletes did not habituate to occupying certain positions or coordinating within certain sub-units of athletes in the drill.

The Invasion Drill

To begin the drill, the ball-carrier at the front and centre of the attack sub-group was instructed to tap the ball with his/her foot, before initiating the attacking sub-phase by advancing forward towards the defence sub-units. In the case that the ball was immediately fumbled during the initiation of the trial, the training group was instructed to restart that trial and the trial in which the mistake was made was not counted. Following a block of 4 practice trials, athletes were told by the researcher that the formal test was beginning. The group of athletes then completed 16 trials of the drill, which allowed each athlete to complete 8 trials of attack and 8 trials of defence, in different positions.

Post-Drill survey

Following completion of all 16 test trials, athletes assembled and were thanked for their participation. Athletes were then instructed to go directly to the side of the field to complete the final Post-Drill survey using their mobile devices.

7.3 Data analysis

7.3.1 Road map for analysis of study predictions

Study predictions were tested by analysing two data sets: 1) Post-Drill survey data, and 2) Pre- and Post-Drill survey data. Post-Tournament data were primarily analysed for a relationship between experiment condition, perceptions of team click, and social bonding. Pre- to Post-Drill data were analysed for a relationship between experiment condition and a *change* in team click and social bonding as a result of the training drill.

7.3.2 Data structure

The *in situ* and field experimental nature of this study meant that the collected data contained multiple levels of dependency: observations were nested within individuals (collected at Baseline, Pre-, and Post-Drill), location (Beijing or Shandong), team (Shandong men, Shandong women, Beijing men or Beijing women), sex, and experiment session. To test relationships between variables of interest, linear mixed effects regression (LMER) models (package *lme4* in the R environment) were used for their ability to model the random structure of the data (see Chapter 6.3.1.1 for full explanation). Intra-class correlation (ICC) estimates were calculated to account for clustering of model residuals according to groupings of athlete sex, team, and specific experiment session. ICC values of $> .15$ were considered meaningful (Field et al., 2012), and informed which random structure to specify in LMER models. Unless otherwise stated, all models controlled for the average performance outcome of each trial (Trial Outcome Average), subjective and objective measures of athlete technical competence, personality (extraversion), and arousal measured Post-Drill.

Data manipulation for Pre- to Post-Tournament analysis

To account for variation over time between Pre- and Post-Drill surveys, variables of interest (individual and team performance relative to prior expectations, team click, social bonding, and fatigue) were calculated by subtracting Pre- from Post-Drill scores for each athlete. The calculation of change scores reduced the complexity

of the data structure down to two levels of analysis, and meant that relationships between these change variables could be modelled using LMER. Change scores of relevant factors were introduced to the model as fixed effects, so their intercepts were allowed to vary according to the random structure of each model.

The item measuring athlete perceptions of overall team performance in the Pre-Drill survey was not framed in terms of expectation violation (but instead in terms of more or less “good” or “poor”). As such, it was not possible to directly compare the Pre- and Post-Drill measures of Team Performance Vs Expectations. Instead, the Post-Drill measure of Team Performance Vs Expectation was used to predict Team Click Change between Pre- and Post-Tournament measurements.

7.3.3 Data reduction

Exploratory factor analysis (EFA) was used to reduce multicollinearity between variables while retaining as much variance as possible in the observed data (Yong & Pearce, 2013, see Appendix E.2.1.1). EFA followed the procedure outlined in the previous empirical chapter (see Chapter 6.4.2). EFAs were performed on clusters of survey items pertaining to performance, team click, and social bonding, directed at both the training group and the athlete’s provincial team as a whole. Moderator variables—technical competence (objective and subjective), components of individual and training team performance, arousal, fatigue, and athlete perception of team discipline—were also reduced to factors. Due to the equivalence of measures between Pre- and Post-Drill surveys, EFAs were conducted on the entire available data (rather than separate EFAs for the Post-Drill and Pre- to Post-Drill subsets).

Perceptions of group and individual performance relative to prior expectations

The main predictor variable of interest, perceptions of training team performance relative to prior expectations (Team Performance Vs Expectations), was a single item measure, and did not require data reduction. Given that most outcome variables of interest were factors standardised as z-scores (with $mean \approx 0$, $SD \approx 1$),

perceptions of team performance relative to prior expectations was also transformed to a standardised z-score so as to accord with explanatory variables in subsequent subsequent linear mixed effects modelling (for an explanation, see Beckmann, Jenkinson, & Smith, 2003, p. 1058).

Mediation analyses

Mediation analyses were conducted using linear mixed effects regressions in the Causal Mediation Analysis package in R (Version 4.4.5). To make inferences concerning the average indirect and total effects, quasi-Bayesian Markov Chain Monte Carlo (MCMC) method based on normal approximation and 1000 simulations was used to estimate the 95% Confidence Intervals (Tofighi & MacKinnon, 2016; Imai et al., 2010). MCMC estimation is a form of non-parametric bootstrapping whereby the sampling distribution for the effect of interest is not assumed to be normal but is instead simulated from the model estimates and their asymptotic variances and covariances (Preacher & Hayes, 2008).

7.3.4 Manipulation Checks: Confidence in team and self

Following the researcher's in-person delivery of the experimental prime and immediately before the training drill, two survey items were administered to test the effectiveness of the experimental manipulation. Athletes were asked to report:

1. Team Confidence: *How confident are you that you will meet the technical challenges of the training drill?*
2. Self Confidence: *How confident are you that your team will meet the technical challenges of the training drill?*

Both items were measured using a 100 point scale (0 = "Not at all confident", 100 = "Extremely confident"). Athlete responses to these items were compared according to experiment condition using LMER to model the random structure of the data, and controlling for technical competence.

7.4 Results

7.4.1 Descriptive Statistics

7.4.1.1 Participants

58 athletes ($men = 31$, $M(age) = 21.33$, $SD = 3.33$, $range = 16 - 29$) participated in the experiment in groups of 8 (or on two occasions, groups of 6). A total of 8 experimental sessions were conducted, with participants each taking part in a session only once. 31 participants were from Shandong province ($men = 15$, $M(age) = 22.1$) and the remaining 27 athletes were from Beijing province ($men = 16$, $M(age) = 20.4$). The experimental groups consisted of athletes from the same province. On 3 separate occasions, a dummy participant stood in for an athlete who failed to attend due to injury or illness. Dummy participants were athletes who were competent in rugby, naive to the predictions of the study, and did not participate in the Pre- or Post-Drill surveys. When conducting experimental trials with the Beijing women's team, only 11 (of a total of 16 recruited) athletes were available to participate in the two sessions. As a compromise, both drills (high and low difficulty) were modified to become a "3 + 2 + 1" version of the Invasion Drill.² In the experiment session in which only 5 fit athletes participated, a dummy participant made up the 6th athlete. Survey data of the remaining 58 participants (and video data of all 64 athletes, including dummy participants) were analysed.

Basic information concerning participants is displayed in Table 7.3. Athletes' average training age (years dedicated to full-time rugby training) was 4.22 years ($SD = 2.11$), and athletes had spent an average of 5.64 years ($SD = 2.08$) in the team. 50% of the sample (29) were either full-time employees of their provincial team (21), or were otherwise employed on a full-time (but fixed term) contract (8). The remaining 29 athletes were employed either on a "student contract" (8 or 14.5%), or on a short term training contract (16 or 29.1%), or on a short-term trial basis (2 or 3.6%). 18 athletes (31%) declared that there were in the starting team of their respective teams.

²Three attackers advanced towards a first line of two defenders and a second line of defence containing only one defender.

Table 7.3: Overview of experiment sample (Overall and by condition (High/Low)).

	Overall	High	Low
n	58	29	29
Age (mean (sd))	21.33 (3.33)	20.48 (3.11)	22.14 (3.39)
Sex = male (%)	31 (53.4)	15 (51.7)	16 (55.2)
Team (%)			
Beijing Men	16 (27.6)	8 (27.6)	8 (27.6)
Beijing Women	11 (19.0)	6 (20.7)	5 (17.2)
Shandong Men	15 (25.9)	7 (24.1)	8 (27.6)
Shandong Women	16 (27.6)	8 (27.6)	8 (27.6)
Position = Starting Team (%)	18 (32.7)	9 (33.3)	9 (32.1)
Training Age (mean (sd))	4.22 (2.11)	3.74 (1.89)	4.68 (2.25)
Years In Team (mean (sd))	5.64 (2.08)	5.37 (1.94)	5.89 (2.20)
AthleteLevel (%)			
1st Level	11 (20.8)	5 (19.2)	6 (22.2)
2nd Level	6 (11.3)	5 (19.2)	1 (3.7)
Master	36 (67.9)	16 (61.5)	20 (74.1)
ContractStatus (%)			
Full time contract	8 (14.5)	3 (11.1)	5 (17.9)
Full time employee	21 (38.2)	10 (37.0)	11 (39.3)
Student contract	8 (14.5)	5 (18.5)	3 (10.7)
Training contract	16 (29.1)	8 (29.6)	8 (28.6)
Trial status	2 (3.6)	1 (3.7)	1 (3.6)

All athlete attributes mentioned above appeared to be evenly matched between conditions, except for key variables of athlete age and training age, which appeared to be higher in the low difficulty condition than in the high difficulty condition. Independent-sample t-tests were conducted to compare key variables of athlete training age and athlete age in the high and low difficulty conditions. Athlete age differed significantly between the high ($M = 20.48, SD = 3.11$) and low ($M = 22.14, SD = 3.39$) difficulty conditions ($t(52.09) = -3.33, df = 162.59, p = .001$). The difference in training age between high ($M = 3.74, SD = 1.90$) and low ($M = 4.68, SD = 2.25$) difficulty conditions, was not significant ($t(52.09) = -1.67, df = 162.59, p = 0.10$).

7.4.1.2 Key variables of interest

Tables 7.5 and 7.6 display main variables of interest by condition (high/low) and time point (Baseline, Pre-Drill, Post-Drill). In general, the central tendency of all survey items was between .5 to 1.5 standard deviations above the mid-point of the scale (50 for 100 points scales such as Tacit Understanding or Emotional Support, or 2.5 for the Fusion and Group Identity scales. For instance, average athlete perceptions of individual performance ranged from a low of 58.31 ($SD = 17.71$) for perceptions of individual performance relative to prior expectations (measured Post-Drill) to a high of 78.62 ($SD = 12.75$) for athlete confidence in group ability to meet the technical challenges of the drill, measured Pre-Drill. Central tendencies of variables measuring athletes' perceptions of team click and social bonding ranged from a low of 68.34 ($SD = 14.69$) for perceptions of tacit understanding measured Post-Drill in the low difficulty condition, to a high of 90.21 ($SD = 9.33$) for perceptions of shared goal with the training group measured Pre-Drill in the low difficulty condition.

Athletes were on average more critical in regards to perceptions of individual performance than they were of group and team performance, and were generally more critical of individual and team performance in the Post-Drill survey than they were in the Baseline and Pre-Drill surveys. Measures relating to team click and social bonding appeared to decrease in the Post-Drill survey relative to the Pre-Drill and Baseline surveys. Confidence in self and the training group to meet the challenges of the training drill did not show obvious signs of variation according to condition.

Objective performance outcome did not noticeably vary across experiment sessions, with the low difficulty experiment sessions averaging 11.83 ($SD = .85$) tries and the high condition only 8 ($SD = 2.20$) tries (the most successful tries scored in an experiment session was 13, while the lowest amount of tries scored in an experiment session was 4). For the more fine grained performance score, "Trial Outcome Average" the average for the low difficulty condition was 4.68 ($SD = .25$), while the average for the high difficulty condition was 3.52 ($SD = .49$). A more detailed report of performance outcome by experiment session is shown in Table 7.7.

Table 7.4: Mean (SD) of key performance variables of interest measured by condition at Baseline, Pre-Drill, and Post-Drill (all $n's = 58$).

Performance Item	Baseline		Pre		Post	
	High	Low	High	Low	High	Low
Objective Performance						
Tries Total					8.00 (2.20)	11.83 (.85)
Trial Outcome Average					3.52 (.49)	4.68 (.25)
Training Group						
Confidence in group to meet technical challenges	-	-	76.03 (17.16)	78.62 (12.75)	-	-
Performance vs prior expectations	-	-	-	-	66.50 (20.64)	66.83 (18.32)
<i>Components:</i>						
Attack	-	-	74.55 (20.93)	75.66 (13.36)	64.07 (24.38)	67.34 (15.61)
Defence	-	-	73.38 (22.09)	77.62 (14.44)	57.04 (25.55)	63.14 (19.90)
On-field communication	-	-	77.76 (16.09)	75.72 (14.84)	66.25 (20.78)	70.66 (15.46)
Support Play	-	-	77.55 (15.65)	75.97 (12.80)	64.46 (25.32)	69.66 (13.72)

Table 7.5: Table Continued: Mean (SD) of key performance variables of interest measured by condition at Baseline, Pre-Drill, and Post-Drill (all $n's = 58$).

Performance Item	Baseline		Pre		Post	
	High	Low	High	Low	High	Low
Individual						
Confidence in self to meet technical challenges	-	-	76.90 (22.65)	77.76 (15.37)	-	-
Overall impression of individual performance	69.07 (18.62)	66.11 (19.47)	65.66 (27.57)	69.90 (17.35)	-	-
Performance vs prior expectations	-	-	-	-	54.22 (25.50)	44.41 (26.83)
<i>Components:</i>						
Passing technique	63.63 (26.69)	61.74 (22.23)	65.83 (20.93)	70.28 (16.21)	59.75 (24.52)	60.21 (22.78)
1 on 1 defence	67.44 (16.83)	60.96 (19.16)	66.76 (19.68)	63.62 (19.56)	66.11 (16.67)	58.69 (23.58)
Support play	67.30 (24.88)	69.19 (14.23)	67.90 (23.13)	70.31 (15.79)	66.61 (21.35)	67.62 (23.05)
Decision making in attack	60.78 (23.72)	59.89 (16.76)	65.93 (20.43)	62.93 (16.89)	67.11 (21.70)	68.21 (14.68)

Table 7.6: Mean (SD) of key Team Click and Social Bonding variables of interest measured by condition at Baseline, Pre-Drill, and Post-Drill (all $n's = 58$).

Item	Baseline		Pre		Post	
	High	Low	High	Low	High	Low
Training Group						
Team Click:						
Tacit understanding	-	-	72.90 (15.77)	72.45 (19.40)	64.64 (20.99)	68.34 (14.69)
Team aura	-	-	78.03 (17.48)	81.79 (11.60)	74.50 (20.54)	76.79 (13.73)
Click pictorial	-	-	4.00 (.89)	3.76 (1.18)	3.75 (.93)	3.45 (1.24)
Reliability of others	-	-	-	-	72.29 (17.79)	68.55 (23.47)
Reliability for others	-	-	-	-	63.46 (14.56)	61.03 (21.33)
Ability extended	-	-	72.28 (16.22)	77.66 (14.33)	61.86 (28.68)	65.86 (18.09)
Social Bonding:						
Emotional support	-	-	78.55 (18.90)	78.69 (24.33)	73.86 (19.61)	76.52 (14.92)
Common goal	-	-	80.79 (24.98)	90.21 (9.33)	79.04 (20.80)	83.62 (15.34)
Fusion (Pictorial)	-	-	4.14 (0.64)	4.31 (.71)	4.00 (1.09)	3.79 (1.52)
Provincial Team						
Social Bonding:						
Emotional support	71.89 (24.66)	77.11 (17.76)	-	-	71.71 (17.46)	76.90 (11.97)
Common goal	81.59 (17.66)	84.96 (16.93)	-	-	82.64 (17.18)	84.28 (14.13)
Fusion (Pictorial)	4.33 (.73)	4.67 (.48)	-	-	4.25 (.75)	4.45 (.63)
Fusion (Verbal)	4.00 (.81)	4.15 (.65)	-	-	3.88 (.76)	4.06 (.61)
Group Identification	4.20 (.78)	4.49 (.57)	-	-	4.16 (.71)	4.40 (.64)

Table 7.7: Objective performance outcomes according to experiment session. Objective performance was measured using a count of total tries scored over the 16 trials, and an average of the quality of performance in each trial (Tries Total and Trial Outcome).

Session	Tries Total	Trial Outcome (Mean (SD))
High difficulty		
Beijing men	13	4.39 (1.82)
Beijing women	11	4.5 (1.9)
Shandong men	9	3.81 (2.04)
Shandong women	10	4.01 (2.01)
Low difficulty		
Beijing men	8	3.31 (1.85)
Beijing women	4	2.75 (1.81)
Shandong men	12	5.00 (1.71)
Shandong women	11	4.75 (1.34)

7.4.2 Data Reduction

7.4.2.1 Components of team performance

Measures of components of team performance in the Invasion Drill (defence, attack, support play, and on field communication) were subjected to EFA. Correlations between group component performance items was very high (all $r's > 0.67$), which suggested that one factor was appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = 0.83, \chi^2(6, N = 116) = 379.28, p = < .001$). One factor, labelled "Team Performance Components" was imposed on the data, which explained 77% of the overall variance ($SSLoading = 3.08$). $Guttman's \lambda = 0.92$ and $Cronbach's \alpha = 0.93$ indicated that the data reduction was appropriate and reliable.

7.4.2.2 Components of individual performance

Components of individual components of performance in the Invasion Drill (1-on-1 defence, passing technique, support play in attack, decision making in attack, and effectiveness in contact) were subjected to EFA. The variable "Effectiveness in contact" was removed from analysis as the Invasion Drill was predominantly a non-contact training drill, and so this item was not relevant to athletes' performance. Correlations between individual component performance items was very high (all $r's > .61$), which suggested that one factor was appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .83, \chi^2(6, N = 116) = 280.70, p < .01$). One factor, labelled "Individual Performance Components" was imposed on the data, which explained 69.1% of the overall variance ($SSLoading = 2.77$). $Guttman's \lambda = .87$ and $Cronbach's \alpha = .90$ indicated that the data reduction was appropriate and reliable.

7.4.2.3 Perceptions of team click within the training group (Team Click)

An EFA was performed on items relating to training group team click (tacit understanding, general atmosphere, click pictorial, and ability extended by the group). Correlations between the remaining items were moderate to strong (all $r's >$

.29), suggesting that one factor was appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .72, \chi^2(6, N = 116) = 127.86, p < .001$). One factor, labelled "Team Click" was imposed on the data, which explained 47.7% of the overall variance ($SSLoading = 2$). $Guttman's \lambda = .73$ and $Cronbach's \alpha = .77$ indicated that the data reduction was appropriate and reliable.

7.4.2.4 Social bonding to the training group (Social Bonding)

Items concerning bonding to the training group (emotional support, shared goal, fusion pictorial) were subjected to EFA. Correlations between items were high (all $r's > .37$), which suggested that one factor would be appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .65, \chi^2(3, N = 116) = 54.23, p < .001$). One factor, labelled "Social Bonding" was imposed on the data, which explained 42% of the overall variance ($SSLoading = 1.26$). $Guttman's \lambda = .59$ and $Cronbach's \alpha = .68$ indicated that the data reduction was appropriate and reliable.

7.4.2.5 Social bonding to the provincial team (Social Bonding (Province))

Measures of bonding to the team (emotional support, shared goal, fusion pictorial, fusion verbal, and group identification) were subjected to EFA. Correlations between items were moderate-to-high (all $r's > .18$), which suggested that one factor would be appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .69, \chi^2(10, N = 116) = 172.59, p < .001$). One factor, labelled "Social Bonding (Province)" was imposed on the data, which explained 39.2% of the overall variance ($SSLoading = 1.96, Guttman's \lambda = .77$ and $Cronbach's \alpha = .76$ indicated that the data reduction was appropriate and reliable).

Technical Competence (objective and subjective measures)

All 8 items relevant to technical competence were analysed in a correlation matrix to assess relatedness. All measures of objective competence were highly correlated all $r's \geq .64$), and among measures of subjective competence (all items except

for the team competence measure correlated at $r > .52$) suggested that the data could be explained by two underlying factors. Team Ability Chinese Provinces was dropped from analysis due to low correlation with other competence variables, possibly because the item did not ask about an individual athlete's competence (it referred instead to an athlete's opinion of the competence of the team of which they were a member).

An EFA of technical competence variables revealed that items of interest loaded on two factors. Measures of objective competence (Years Team, Training Age, Team Status, Athlete Status) loaded on the first factor, which was labelled "Objective Competence" because the measures were all objective markers of an athlete's competence. Objective Competence explained 41% of the total variance ($SS_{Loading} = 2.87$). The remaining measures of subjective competence (Ability Teammates, Ability Chinese Pros, Ability International Pros) loaded on the remaining factor. The second factor was labelled "Subjective Competence", due to the fact that all measures were the product of athlete self-report. Subjective competence explained 23% of the variance ($SS_{Loading} = 1.62$). $Guttman's \lambda = .86$ and $Cronbach's \alpha = .79$ indicated that the data reduction was appropriate and reliable.

Arousal

Items associated with physiological arousal measured pre- and Post-Drill were subjected to EFA. Correlations between items were all reasonably high (all $r's > .41$), which suggested that one factor would be appropriate. The KMO index and Bartlett's test both suggested high sampling adequacy, ($KMO = .64$, $\chi^2(3, N = 116) = 116.12$, $p < .01$). One factor, labelled "Arousal" was imposed on the data, which explained 58.7% of the overall variance ($SS_{Loading} = 1.76$). $Guttman's \lambda = .74$ and $Cronbach's \alpha = .78$ indicated that the data reduction was appropriate and reliable.

7.4.2.6 Correlation of factors

Post-Drill

Table 7.8 displays correlation values of key factors of interest for the Post-Drill data.

All values were low- to moderate; except for Team Performance Components and Team Performance Vs Expectations (.64), and Team Click and Social Bonding (.79).

Table 7.8: Training Experiment Correlation Matrix (Post Drill)

	Group Confidence	Self Confidence	Team Performance vs Expectations	Indiv. Performance vs Expectations	Team Click	Social Bonding (Group)	Social Bonding (Province)
Group Confidence	1	0.65	-0.04	0	0.25	0.32	0.27
Self Confidence		1	-0.08	-0.04	0.19	0.29	0.27
Team Performance vs Expectations			1	0.26	0.58	0.33	0.28
Indiv. Performance vs Expectations				1	0.26	0.09	-0.05
Team Click					1	0.7	0.7
Social Bonding (Group)						1	0.79
Social Bonding (Province)							1

Pre- to Post-Drill

Table 7.9 displays correlation values of key factors of interest for the Pre- to Post-Drill data. All values were low- to moderate, except for Team Performance Components and Team Performance Vs Expectations (.64). The correlation between key outcome variables, Team Click Change and Social Bonding Change, was moderate (.37).

Table 7.9: Training Experiment Correlation Matrix (Pre-Post)

	Team Performance Components	Team Performance vs Expectations	Indiv. Performance Components	Indiv. Performance vs Expectations	Team Click Change	Social Bonding Change (Group)	Social Bonding Change (Province)
Team Performance Components	1	0.64	-0.09	0.07	-0.26	0.32	-0.11
Team Performance vs Expectations		1	-0.07	0	-0.33	0.17	-0.09
Indiv. Performance Components			1	0.25	0.53	0.04	0.1
Indiv. Performance vs Expectations				1	0.2	0.01	0
Team Click Change					1	0.37	0.24
Social Bonding Change (Group)						1	0.44
Social Bonding Change (Province)							1

Table 7.10: ICC values for experiment session, sex, provincial team, and location.

Variable	Session	Sex	Team	Location
Group Performance Vs Expectations	0.06	0.06	0.08	0.01
Team Click	0.14	-0.03	0.09	0.08
Social Bonding	0.21	-0.01	0.18	0.15
Social Bonding (Provincial)	0.05	0.06	0.08	-0.04

7.4.3 ICC values

Post-Drill data

ICC values for variables of interest (shown in Table 7.10) indicated meaningful clustering (i.e. $ICC < .10$) in the data according to experimental session (8 in total), provincial team (Beijing men's, Beijing women's, Shandong men's, Shandong women's). Given the constraints on model complexity imposed by the relatively small sample size of the study, experiment session was chosen as a level 2 grouping variable (owing to marginally higher ICC values). To account for clustering within each experiment session, Experiment session was modelled as a random effect using the intercept only (models that included both the intercept and the slope failed to converge due the large number of groups relative to sample size). High variation in objective performance outcomes further supported the decision to account for variation attributable to experiment session (see Appendix 7.7).

7.4.4 Change in factors over time

Table 7.11 shows that the Post-Drill measures of Team Performance Components, Individual Performance Components, Team Click, and Social Bonding, were all considerably lower than Pre-Drill measurements. The differential between athlete perceptions of confidence in group and individual ability to meet the challenges of the drill and perceptions of group and individual performance relative to expectations was also striking: the mean of questions relating to group (63.37, $SD = 21.23$)

Table 7.11: Mean (SD) for factors at Baseline, Pre-, and Post-Drill.

	Baseline	Pre	Post
n	58	58	58
Performance			
Team Confidence		77.33 (15.04)	
Team Vs Expected			63.37 (21.23)
Team Components		.27 (.86)	-.28 (1.01)
Ind. Confidence		77.33 (19.19)	
Ind. vs expected			49.23 (26.42)
Ind. components	-.05 (.98)	.10 (.93)	-.06 (.97)
Team Click			
Training Group		.19 (.85)	-.19 (.97)
Training Group Post (5 item)			-.00 (.93)
Social Bonding			
Training Group		.12 (.81)	-.12 (.85)
Team (Province)	.02 (.93)		-.02 (.84)
Moderators			
Arousal		-.22(.94)	.23 (.92)

compared to individual (49.23, $SD = 26.42$) performance relative to prior expectations were much lower than initial confidence in individual (77.33, $SD = 19.19$) and group (77.33, $SD = 15.04$) ability. Thus, key variables of interest appeared to reduce in value between Pre- and Post-Drill measures.

New variables were created which expressed each individual athlete's change in variables of team click and social bonding between two time points. Values at time Pre-Drill (or Baseline in the case of the Social Bonding (Province) variable) were subtracted from values at time Post-Drill to create a new variable. Relationships between these new variables ("Team Click Change," "Social Bonding Change,"

“Social Bonding (Province) Change”) were used to analyse study predictions. Measures of performance relative to prior expectation were not suitable for this transformation, as the pre- training drill measures of performance were not phrased in terms of prior expectation. Instead, the Post-Drill measure of performance was used to predict change in outcome variables.

7.5 Analysis of study predictions

7.5.1 Prediction 1.a: Higher levels of uncertainty in joint action will generate lower confidence for success of team performance

LMER models controlling for Objective and Subjective Competence (fixed) and experiment session (random) were used to assess the effect of Condition on athlete confidence in the abilities of the group (Team Confidence) and self (Self Confidence) to meet the technical challenges of the drill.

The effect of Condition on Team Confidence was not significant ($B = .01$ (95%CI = $-.42, .44$), $SE = .22$, $t(54) = .05$, $p = .96$). The model did reveal significant positive effects of Objective Competence ($B = .49$ (95%CI = $.27, .72$), $SE = .11$, $t(54) = 4.30$, $p < .001$) and Subjective Competence ($B = .49$ (95%CI = $.25, .73$), $SE = .12$, $t(54) = 4.00$, $p < .001$) on Team Confidence, which suggested that athletes’ objective and perceived technical competence influenced confidence in group ability to meet the impending challenges of the training drill.

Similarly, the effect of Condition on Self Confidence was also not significant ($B = .09$ (95%CI = $-.42, .59$), $SE = .26$, $t(54) = .05$, $p = .74$). The model did reveal significant positive effects of Objective Competence ($B = .38$ (95%CI = $.13, .65$), $SE = .13$, $t(54) = 2.90$, $p < .001$) and Subjective Competence ($B = .29$ (95%CI = $.01, .58$), $SE = .14$, $t(54) = 2.04$, $p = .05$) on Individual Confidence, which suggested that an athlete’s objective and perceived technical competence influenced confidence in individual ability to meet the impending challenges of the training drill.

These results did not support the prediction that higher levels of uncertainty in joint action will generate lower confidence for success of team performance in joint

action. It could be inferred that the experimental prime did not successfully manipulate athletes' explicit expectations around performance prior to the Invasion Drill.

7.5.2 Prediction 1.b: Higher levels of uncertainty in joint action will generate more positive perceptions of team performance relative to prior expectations

The effect of Condition on Team Performance Vs Expectations was not significant ($B = -.64(95\%CI = -.42, .44), SE = .59, t(8.18) = -1.08, p = .31$). No other main effects of the model were significant.

7.5.2.1 Results by condition

It was still possible that the experimental prime influenced athletes implicitly, in ways that were not measured by athlete self-report Pre-Drill. As such, condition-wise effects in key variables of interest were tested.

Team Click

Post-Drill: the effect of Condition on Team Click was not significant ($B = .43(95\%CI = -.44, 1.30), SE = .44, t(54) = .98, p = .33$). The model did reveal significant positive effects of Subjective Competence on Team Click ($B = .27(95\%CI = .003, .54), SE = .45, t(54) = 1.99, p = .05$), which suggested that higher levels of self-professed technical competence predicted feelings higher levels of team click.

Pre- to Post-Drill: the effect of Condition on Team Click Change was not significant ($B = -.47(95\%CI = -1.47, .54), SE = 2.20, t(53) = -.914, p = .37$). No other main effects of the model were significant. Results of the model suggested that Condition did not significantly predict change in athlete perceptions of team click.

Social Bonding

Post-Drill: the effect of Condition on Social Bonding was not significant ($B = .33(95\%CI = -.45, 1.10), SE = .40, t(54) = .83, p = .41$). There were no other significant main effects.

Pre- to Post-Drill: the effect of Condition on Social Bonding Change was not significant ($B = -.39(95\%CI = -.42, .44), SE = .49, t(53) = -.79, p = .96$). There were no other significant main effects.

These results suggested that Condition did not significantly predict athlete perceptions of social bonding to the training group, or change in perceptions of social bonding with the training group.

Social Bonding (Province)

Post-Drill: The effect of Condition on Social Bonding (Province) was not significant ($B = -.23(95\%CI = 1.30, 1.37), SE = .39, t(53) = .18, p = .75$). There were no other significant main effects of the model.

Pre- to Post-Drill: the effect of Condition on Social Bonding (Province) was not significant ($B = .17(95\%CI = -.23, 1.30), SE = .39, t(8.2) = .33, p = .75$). There were no other significant main effects of the model.

Together, these results suggest that experiment condition did not predict variation in social bonding to the category of the provincial team as a whole.

7.5.2.2 Exclusion of cases

Results indicated that there were no clear observable effects of condition on variables of interest. One possible explanation for these results is that the study design and the unconstrained nature of the training drill made it difficult to ultimately control for the quality of performance in joint action (discussed in more detail in Section 7.6). It was possible that uncontrolled variation in objective performance in each experiment session was driving perceptions of performance (versus prior expectations). To investigate this possibility, both data subsets were analysed for a relationship between objective performance outcomes (Tries Total and Trial Outcome Average) and athlete perceptions of performance (Team Performance Vs Expectations).

Tries Total: results of an LMER model revealed that the relationship between Tries Total and Team Performance Vs Expectations was not significant ($B = -.02(95\%CI = -.55, .51), SE = .27, t(12.54) = -.07, p = .95$). No other main effects

in the model (arousal, objective and subjective measure of technical competence, and personality(extraversion)) were significant.

Trial Outcome Average: Results revealed that the relationship between Trial Outcome Average and Team Performance Expectations was not significant, ($B = -.02(95\%CI = -.16, .12), SE = .07, t(10.58) = -.07, p = .95$). No other main effects were significant.

These results provided no justification for a relationship between objective performance outcome and perceptions of team performance relative to prior expectations. As such, no cases were excluded from the data.

Summary of results for Prediction 1.a and 1.b

Results reported here failed to support the predictions that higher levels of uncertainty in joint action scenarios predict lower levels of expectations concerning team performance (Prediction 1.a), and higher levels of positive expectation violation (Prediction 1.b).

To investigate the extent to which the collected data could explain the remaining predictions of this study, both data subsets (Post-Drill and Pre- to Post-Drill) were collapsed into one overall sample for subsequent analysis.

7.5.3 Prediction 2: More positive perceptions of team performance relative to prior expectations will predict higher levels of team click

Post-Drill

Results of the Post-Drill data supported this prediction. There was a significant main effect of Team Performance Vs Expectations on Team Click ($B = .57(95\%CI = .23, .90), SE = .17, t(5.40) = 3.21, p = .02$), indicating that more positive perceptions of team performance relative to prior expectations predicted perceptions of team click (see Figure 7.2). All other main effects were not significant (see Appendix F.3 Table F.1).

Model residuals were normally distributed around zero ($W = .99, p = .97$) and an analysis of Cook's distances suggests that the model did not contain any observations

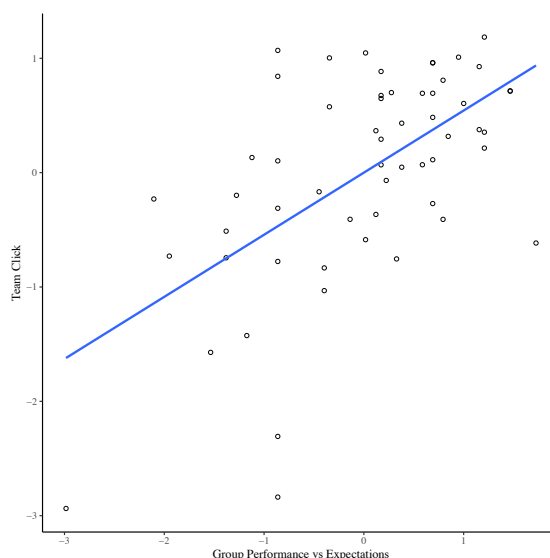


Figure 7.2: Prediction 2 (Post-Drill): Team Performance Vs Expectations predicts Team Click ($n = 53$). Both variables are normalised with mean of zero and SD of one.

that unjustifiably influenced parameter estimates (all *Cook's Distances* $< .49$), for full presentation of model assumptions, see Appendix F.3 Figure F.1). These results suggest that more positive perceptions of team performance relative to prior expectations predicted stronger perceptions of team click.

Pre- to Post-Drill

Results of the Pre- to Post-Drill survey also supported this prediction. There was a significant main effect of Team Performance Vs Expectations on Team Click Change ($B = .54$ ($95\%CI = .30, .78$), $SE = .12$, $t(53) = 4.37$, $p < .001$), indicating that greater positive change in perceptions of team performance relative to prior expectations predicts positive change in perceptions of team click (see Figure 7.3). All other main effects were not significant (see Appendix F.3 Table F.2).

Model residuals were normally distributed around zero ($W = .98$, $p = .44$) and an analysis of Cook's distances suggests that the model did not contain any observations that unjustifiably influenced parameter estimates (all *Cook's Distances* $< .34$), for full presentation of model assumptions, see Appendix F.3 Figure F.2). Results suggested that change in perceptions of team performance were a positive predictor of increase in perceptions of team click following the training drill. Results from

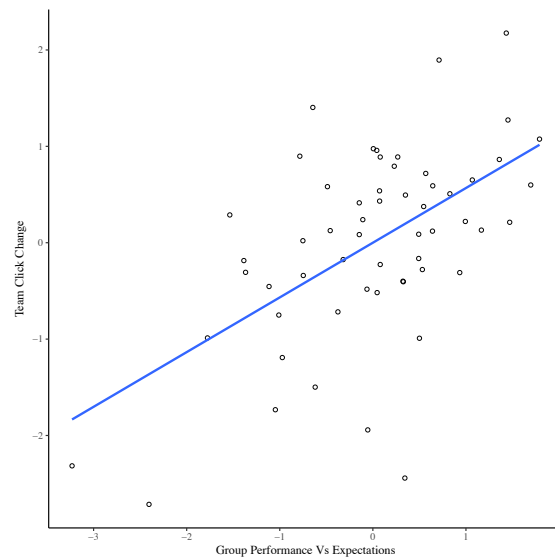


Figure 7.3: Prediction 2 (Pre- to Post-Drill): Team Performance Vs Expectations predicts Team Click Change ($n = 53$). Both variables are normalised as z-scores.

both Post-Drill and Pre- to Post-Drill subsets were in line with the prediction that more positive perceptions of team performance relative to prior expectations predicts perceptions of team click.

7.5.4 Prediction 3: Higher levels of team click will predict higher levels of social bonding (to the training group or provincial team)

Prediction 3.a: Perceptions of team click predict perceptions of social bonding to the training group

Post-Drill

Results of the Post-Drill survey supported this prediction. The model revealed a significant main effect of Team Click on Social Bonding ($B = .63(95\%CI = .46, .79), SE = .09, t(53) = 7.28, p < .01$), indicating that stronger perceptions of team click predict stronger perceptions of social bonding to the training group (see Figure 7.4). All other main effects of the model were not significant. Model residuals were normally distributed around zero ($W = .99, p = .80$) and there were

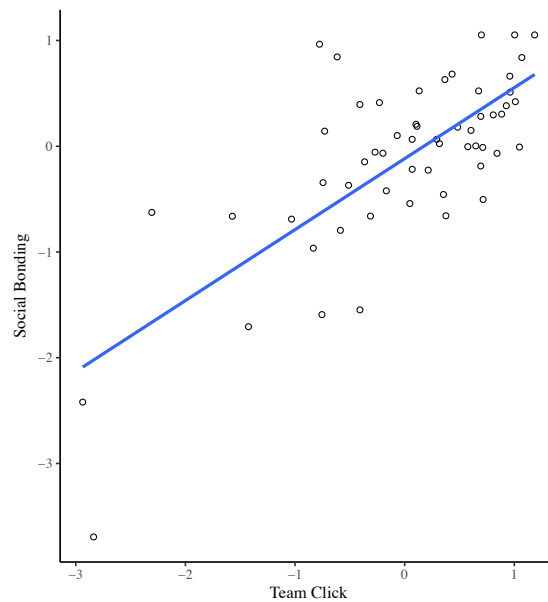


Figure 7.4: Prediction 3.a (Post-Drill): Team Click predicts Social Bonding ($n = 53$). Both variables are standardised factors ($mean = 0$, $SD = 1$).

no unjustifiably influential cases (all *Cook's Distances* $< .6$, see model assumptions in Appendix F.3 Figure F.3).

Pre- to Post-Drill

Results of the Pre- to Post-Drill survey also offered support for this prediction. A LMER revealed a significant main effect of Team Click Change on Social Bonding Change ($B = .27(95\%CI = .01, .50)$, $SE = .13$, $t(53) = 2.05$, $p < .05$), such that an increased change in team click predicted an increased change in social bonding (see Figure 7.5). All other main effects of the model were not significant (see Appendix F.3 Table F.4). Model residuals were normally distributed around zero ($W = .96$, $p = .08$), and Cook's Distances were less than .5, indicating that the model did not to contain any observations that unjustifiably influenced parameter estimates (see Appendix F.3 Figure F.4 for model assumptions).

Prediction 3.b: Perceptions of team click predict perceptions of social bonding to the provincial team

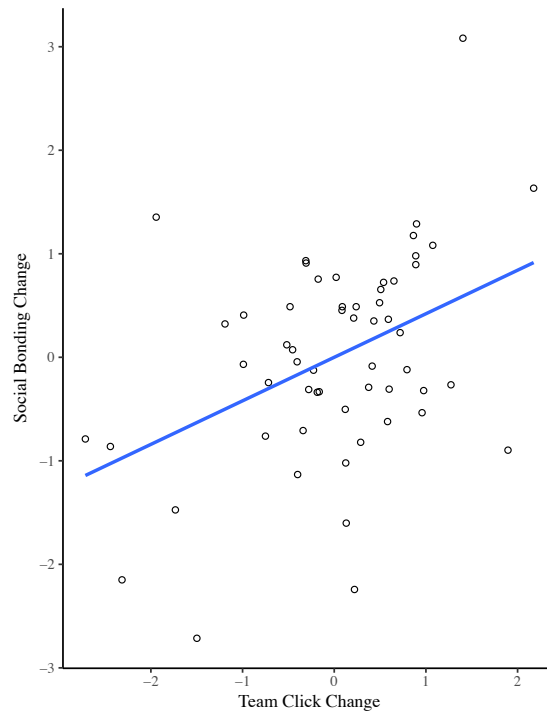


Figure 7.5: Prediction 3.a (Pre- to Post-Drill): Team Click Change predicts Social Bonding Change ($n = 53$).

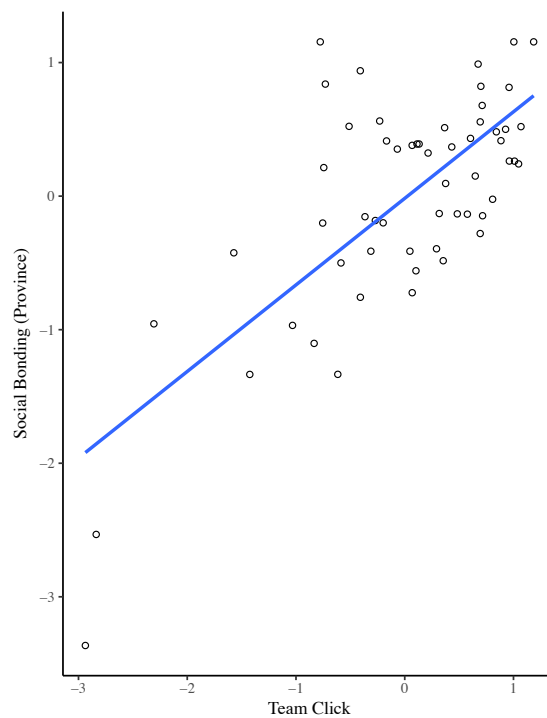


Figure 7.6: Prediction 3.b (Post-Drill): Team Click predicts Social Bonding (Province) ($n = 53$).

Post-Drill

Results of the Post-Drill survey supported this prediction. The model revealed a significant main effect of Team Click on Social Bonding (Province) ($B = .50(95\%CI = .21, .79), SE = .15, t(5.13) = 3.442, p = .02$), indicating that stronger perceptions of team click predicted stronger perceptions of social bonding to the provincial team (see Figure 7.6). All other main effects of the model were not significant (Appendix F.3 Table F.5. Model residuals were normally distributed around zero ($W = .96, p = .10$) and there were no unjustifiably influential cases (all $Cook'sDistances < .7$, see Appendix F.3 Figure F.5 for model assumptions).

Pre- to Post-Drill

The main effect of Team Click Change on Social Bonding (Province) Change was not significant, ($B = .19(95\%CI = -.11, .48), SE = .14, t(47.51) = 1.25, p < .05$). All other main effects of the model were not significant. This result suggested that change in perceptions of team click did not predict change in perceptions of social bonding to the provincial team.

7.5.5 Prediction 4: More positive perceptions of team performance relative to prior expectations will predict higher levels of social bonding (to the group and provincial team)

Prediction 4.a: More positive violations of team performance expectations will predict higher levels of social bonding to the training group

Post-Drill

A LMER model revealed that the main effect of Team Performance Vs Expectations on Social Bonding was not significant, ($B = .25(95\%CI = -.10, .59), SE = .18, t(5.21) = 1.39, p = .22$). The only significant main effect of the model was arousal, ($B = .23(95\%CI = .01, .44), SE = .11, t(39.37) = 2.10, p = .04$), suggesting that reports of higher arousal at the end of the drill were significantly associated

with higher levels of social bonding. These results did not directly support the prediction that more positive violations of expectations around team performance would also predict higher levels of social bonding.

Pre- to Post-Drill

Models of the Pre- to Post-Drill data also produced similar results. A LMER model revealed that the main effect of Team Performance Vs Expectations on Social Bonding Change was not significant, ($B = -0.03$ (95%CI = $-.44, .39$), $SE = .21$, $t(7.57) = -.12$, $p = .91$). The model did reveal a significant main effect of Ind Performance Vs Expectations on Social Bonding Change, ($B = .28$ (95%CI = $.02, .55$), $SE = .13$, $t(49.39) = 2.13$, $p = .04$), suggesting that more positive increase in perceptions of individual performance predicted more positive increase in social bonding between Pre- and Post-Drill surveys. However, these results did not directly support the prediction that more positive violations of expectations concerning team performance would predict higher levels of social bonding.

Taken together, results did not support the prediction that perceptions of team performance relative to prior expectations directly predict social bonding.

Prediction 4.b: More positive violations of team performance expectations will predict higher levels of social bonding to the provincial team

Post-Drill survey

A LMER model revealed that the main effect of Team Performance Vs Expectations on Social Bonding (Province) was not significant, ($B = .24$ (95%CI = $-.02, .49$), $SE = .13$, $t(8.62) = 1.83$, $p = .10$). No other main effects in the model were significant.

Pre- to Post-Drill survey

A LMER model revealed that the main effect of Team Performance Vs Expectations on Social Bonding (Province) Change was not significant, ($B = .16$ (95% $CI = -.44, .39$), $SE = .21$, $t(8.97) = .714$, $p = .49$).

Results of both models did not support the prediction that perceptions of team performance relative to prior expectations directly predict social bonding to the provincial team.

7.5.5.1 Prediction 5: Perceptions of team click will mediate a relationship between more positive violations of expectations around team performance and social bonding to the group

Due to the fact that the direct path between Team Performance Vs Expectations did not significantly predict social bonding (to the training group or to provincial team), a mediation analysis was not appropriate.

7.6 Discussion

This study was designed to investigate the phenomenon of team click in a controlled field experiment. Here, uncertainty was manipulated to observe its predicted effect on expectations concerning team performance. Results did not show evidence for the primary prediction that higher levels of uncertainty in joint action will generate more positive perceptions of team performance relative to prior expectations (Prediction 1.b). These results appeared to be explained by the failure of the experiment design to successfully manipulate athlete perceptions of confidence (Prediction 1.a). Granting the possibility that the manipulation was effective but was not reflected in self-report measures, data were analysed for condition-wise effects, but results suggested no evidence for study predictions.

These results thus suggest two possible implications: the experiment did not successfully manipulate uncertainty in joint action, or the hypothesis concerning the role of uncertainty in joint action is incorrect. In this discussion I will first attempt to account for factors of experiment design and execution that support the first implication, before attending to the question of hypothesis validity.

Considering limitations with experiment design, it is highly likely that the manipulation failed to sort variation in athlete expectation by condition. The design of this experiment enabled control over athlete expectations prior to drill, but it did not enable control for the success of performance in the drill. Piloting of the Invasion Drill with junior athletes of the Beijing rugby program established a difficulty rating of 4.7 out of 10 (range = 3–7), relative to a less complex “2+1+1” drill (difficulty = 2, range = 2–4), and a more complex “6 on 4 continuous” drill (difficulty = 6.2, range = 4–10; $n = 20$). Based on these results, it was deemed that the Invasion Drill would establish a middling difficulty. In other words, given non-trivial levels of coordination required of athletes in the Invasion Drill, it was not expected that all trials within each experiment session would be a roaring success. Considering also the possibility of high variation in training age and experience with rugby within each experimental session, it could be expected that performance

would vary. Indeed, results suggest within- and between-group variation in objective performance, irrespective of experimental condition (see Table 7.7).

To overcome this issue, at least two foreseeable solutions exist. First, the same experiment could be run with a larger sample size, and cases could be selected based on a pre-determined base level of objective (successful) performance. As such, the effect of the manipulation of uncertainty could be examined using a subset of successful performances only. In this study, there was no relationship between objective performance and expectation violation, and the small sample size made exclusion of data unsuitable. Indeed, the field experiment format of this study also meant that collection of more data was a practical challenge.

Alternatively, alterations to the experiment design could enable more satisfactory control for athlete performance, and, in turn, athlete expectation violation. An ideal experiment would involve a reliable comparison between levels of positive violation of expectation, with performance held constant. This design would enable testing of the hypothesis that team click (and social bonding) will be higher when *successful* team performance comes as a surprise vs. when it does not come as a surprise. Future pilots of this paradigm (or one like it) would establish a measurably successful manipulation, on which the outcome variables of interest to this thesis, namely team click and social bonding, could be re-examined.

In addition to these considerations, it was also possible that the experiment manipulation was too subtle, or that the training paradigm was too mundane to arouse variation in expectations surrounding team performance. The manipulation—delivered electronically via WeChat and then verbally immediately pre-drill—was relatively subtle. Moreover, the manipulation was designed and delivered by a researcher who spoke Chinese as a second language, and was thus perhaps unable to manufacture sufficient levels of attention and believability. In contrast to the high-stakes, high-intensity National Tournament (see Chapter 6), this study was conducted as part of athletes' usual training regime, and with very little obvious consequentiality or reward for participation or performance (athletes were not, for example, reimbursed for participating in the experiment). In addition, the

limitations of research context, namely time constraints and access to athletes, were such that pilot phase was not exhaustive as it could have been (only 2 trials per condition were ran). These limitations are representative of the types of methodological challenges associated with attempting to bring the laboratory to the field (Xygalatas et al., 2013).

Future manipulations of uncertainty and expectation in joint action should also consider the use of measures beyond self-report to ascertain manipulation effectiveness and to measure expectation violation. As discussed in Chapter 2, experimental manipulations of uncertainty have shown effects on various physiological and autonomic responses such as heart rate (Averill et al., 1972) and skin conductance (Epstein & Roupenian, 1970). While not explicitly designed to feature as a check for effectiveness of the experimental manipulation, arousal was measured in this experiment. However, a follow-up analysis revealed no significant effect of condition on athlete pre-drill arousal ($B = .07(95\%CI = -.29, .44), SE = .19, t(53) = .38, p = .71$).

Despite these methodological limitations, the study did offer some confirmation for predictions. A supplementary analysis of a collapsed sample of athletes confirmed results of the previous study. Namely, athletes who did experience more positive perceptions of team performance relative to prior expectations (regardless of condition) also perceived higher perceptions of team click (Prediction 2). Higher levels of team click also significantly predicted higher levels of social bonding, to the training group and to the athlete's provincial team (Prediction 3). The direct relationship between perceptions of performance relative to prior expectations and social bonding was not significant, and thus the prediction that team click mediates a relationship between positive expectation violation and social bonding was not supported (Prediction 5). These findings extend the empirical substantiation of a general theory of team click in group exercise settings, while also leaving many important theoretical and empirical questions to be considered. I will attend to some of these questions in the following chapter by way of concluding this thesis.

By long years of military experience he knew, and with the wisdom of age understood, that it is impossible for one man to direct hundreds of thousands of others struggling with death, and he knew that the result of a battle is decided not by the orders of a commander-in-chief, nor the place where the troops are stationed, nor by the number of canons or of slaughtered men, but by that intangible force called the spirit of the army, and he watched this force and guided it in as far as that was in his power. . .

— Leo Tolstoy (1956)

8

General Discussion

8.1 Overview

Group exercise in human sociality is an intriguing evolutionary puzzle, and thorough scientific explanations for its prevalence in the human record are currently limited. This thesis developed and tested a novel theoretical account of team click in group exercise.

Sporting anecdote and ethnography suggests that team click is a mysterious yet unmistakable experience of peak performance in joint action. In this thesis, I developed a general account of team click grounded in a dynamical theory of cognition (the AIF, see Chapter 2.4.2). A dynamical approach enabled the generation of hypotheses capable of accounting for the coordination of physical and social processes in instances of team click, and in real-world group exercise settings more broadly. Following formulation of a general account of team click (Chapter 2), I situated (Chapters 3 and 4), assessed (Chapter 5), and tested (Chapters 6 and 7) this theory in the real-world group exercise setting of rugby in China. By providing evidence that team click mediates a relationship between perceptions of performance and social bonding in joint action, this thesis offers preliminary substantiation of a general account of team click in group exercise. Findings of this thesis also suggest that positive violation of expectations concerning team

performance may precede team click, and function to draw attention to its visceral and socially agentic dimensions. This chapter will provide a discussion of the findings, point to their limitations, and propose areas for future research. More fundamentally, in this discussion I propose that future development of the theory of team click in group exercise could serve as a valuable complement to existing theories of group exercise and social bonding.

8.2 Synopsis of findings

8.2.1 Ethnographic evidence validated research hypotheses

Ethnographic evidence from rugby in China situated and validated research hypotheses of a general account of team click. Following an introduction to the research setting, I situated a general account of team click through an ethnography of the Beijing men's rugby team. Results demonstrated that athlete experience of rugby's joint action was associated with salient levels of uncertainty and coordination. In addition, I found clear evidence to suggest that athletes experienced visceral and socially agentic dimensions hypothesised to underpin team click.

8.2.1.1 Rugby in China entailed uncertainty and coordination

First, ethnographic evidence validated the claim that team click emerges from a dynamical relationship between uncertainty and coordination in joint action (see Chapter 2.4.3). Evidence that athletes experienced rugby's joint action as challenging, with team performance perceived as more challenging than individual performance, supported the suggestion that the parameters of joint action in rugby reliably generated uncertainty. Athlete testimonies relating to the importance of on-field awareness as a mitigating strategy for the challenges of joint action, and the fact that awareness appeared to develop with familiarity with the sport, was treated as evidence to suggest that, along with perceptions of uncertainty, rugby's joint action also entailed perceptions of coordination. From these results it was possible to suggest that higher levels of perceived difficulty associated with components of team performance were associated with lower expectations for team

performance success, and that this relationship was underwritten by levels of uncertainty in joint action. Thus, ethnographic evidence validated H2a: that higher levels of uncertainty in joint action were associated with lower expectations for team performance success (denoted by perceived difficulty or challenge). These results suggested that despite the diversity of cultural affordances salient in the Beijing men's rugby team, the set parameters of rugby's joint action reliably fostered experiences of physical and social coordination.

This ethnographic analysis demonstrated the importance of detailed contextualisation of theoretical claims when performing *in situ* research. Evidence reported in Chapter 4 demonstrated that diverse cultural processes can act as affordances that shape athlete perceptions of uncertainty and coordination in joint action (Ramstead et al., 2016). Athletes appeared to navigate the challenges of on- and off-field coordination through recourse to a dominant relational mode of social cognition. As a researcher not indigenous to this relational mode, I often experienced group processes as jarring and counter-intuitive. But, over time, I learnt that processes of coordination were imbued with a deeply social logic, of which athletes' strategic pursuit of life-course opportunities of education, concerns for relational *guanxi* networks, and group ethics of personal cultivation were all constituent components. From these results I inferred that athlete experience of uncertainty and coordination in joint action were both present and salient, albeit in terms that expressed a relational mode of social cognition that was distinct from my own deep-seated intuitions as a researcher familiar with rugby contexts elsewhere. Here, the concept of cultural affordances (Ramstead et al., 2016) allowed for a conception of the relationship between uncertainty and coordination, upon which the general account of team click is grounded. In effect, I inferred from ethnographic data that affordances pertaining to rugby's joint action parameters, contemporary China's relational mode of social cognition, and specific strategic motivations for adherence to rugby, interacted to enable and constrain experience of joint action. In sum, this ethnographic situation of dynamical principles of joint

action of rugby in China validated further application and testing of a general theory of team click in group exercise.

8.2.1.2 Team click existed in context

Having identified the key variables of relevance to a general account of team click, I presented evidence that overwhelmingly confirmed athlete recognition and perceptions of the phenomenon of team click. Perceptions of team click appeared to be derived from athlete perceptions of team and individual performance, including the experience of positive violation of expectations concerning success of joint action. Evidence also suggested that athletes experienced stress, anxiety, and guilt related to pressure of performance, which can be taken as indirect evidence for the way in which the uncertainty of joint action bears upon processes of physical and social coordination. Together, these results validated the hypothesis that more positive violation of team performance expectations predicted higher levels of team click (H2b). Further, evidence of an immediate and automatic tendency to utilise social explanations (rather than purely technical explanations) for team click (or its lack) suggested that higher levels of team click may lead to higher levels of social bonding (H1b). In essence, perceptions of team click could translate into positive social explanations characteristic of social bonding. Taken together, results from the ethnographic components of this thesis served to confirm the validity of core theoretical claims of a general theory of team click in group exercise, and encouraged the formulation of testable predictions and field experimental research methods.

According to my knowledge of published literature, this analysis represented the first thorough ethnographic portrayal of contemporary Chinese athletes since anthropologist Susan Brownell's (1995) seminal work. Also based on my knowledge of available literature, this analysis represents the first attempt to situate dynamical principles of uncertainty (i.e., variational free energy (Friston, 2010), coordination (Kelso, 2009), and cultural affordances (Ramstead et al., 2016) in joint action to a real-world ethnographic setting. Results should therefore be understood in this context—as novel contributions that raise as many questions as they answer.

8.2.2 Field experiments confirm core hypothesis but leave key questions unanswered

Overall, findings from two field experiments served to confirm the core hypothesis of this thesis (H1), but also left many questions concerning mechanistic underpinnings of team click unresolved (H2).

8.2.2.1 Team click mediates a relationship between joint action and social bonding in a high-stakes National Tournament

Findings showed that athlete perceptions of team click mediated a relationship between joint action and social bonding (H1) in a high-stakes *in situ* professional rugby tournament in which uncertainty in joint action was assumed to be high. Specifically, results revealed significant relationships between positive perceptions of team performance and team click (Prediction 1a), as well as team click and social bonding (Prediction 1b). The direct relationship between perceptions of team performance and social bonding was also significant (Prediction 1c), and evidence of this significant direct path motivated mediation analyses in which the direct effect of perceptions of team performance on social bonding was fully explained by perceptions of team click (Prediction 1d). In addition, results showed that more positive perceptions of team performance relative to prior expectations predicted higher levels of team click (Prediction 2a). The direct relationship between more positive perceptions of team performance and social bonding was not significant (Prediction 2b). Taken together, these results offered the first empirical substantiation of a theory of team click in group exercise. On average, athletes who felt the click of joint action also reported higher levels of social bonding to their team.

In addition to this result, additional results suggested that positive violation of expectations concerning team performance preceded team click (Prediction 2a), potentially by serving to direct athlete attention to visceral and socially agentic experiences associated with team click. However, results did not support the predicted direct relationship between positive expectation violation and social bonding (Prediction 1b), which suggested that positive expectation violation did not drive bonding effects in joint action.

8.2.2.2 Training experiment failed to manipulate uncertainty (or control for performance)

The results of a follow-up training experiment did not directly confirm the hypothesis that better-than-expected execution of joint action will mediate a relationship between prior levels of uncertainty and team click (H2). Motivated by ethnographic and theoretical evidence to suggest that uncertainty should be a factor in athlete experience (see Chapter 4.3.1), a field experiment was designed in which uncertainty was manipulated via pre-drill prime of high or low difficulty. Manipulation checks suggested that the experimental manipulation failed to successfully alter athletes' prior expectations for team performance (i.e., confidence in team performance; (Prediction 1a), or perceptions of team performance relative to prior expectations (Prediction 1b). The fact that the experimental design did not satisfactorily control for levels of performance may have explained the fact that no significant condition-wise effects were found.

Following these null results, a supplementary analysis was performed, in which participants were collapsed into one data set. Results of this analysis did confirm the prediction that more positive perceptions of team performance relative to prior expectations were associated with higher levels of team click (Prediction 2), and higher levels of team click were also significantly associated with higher levels of social bonding (Prediction 3), to the training group and to the Provincial team (in the Post-Tournament data set only). More positive violations of expectations concerning team performance did not directly predict social bonding (Prediction 4) and, as such, the relationship between positive expectation violation and social bonding mediated by team click could not be appropriately assessed (Prediction 5). While these findings offered some confirmation of results reported in the National Tournament study, the failure of the experimental manipulation raised concerns around 1) the validity of hypothesis concerning the role of uncertainty in joint action, and 2) methodological approaches to field experiment design, including the challenges associated with operationalising and quantifying dynamical processes such as uncertainty, coordination, team click, and their social effects *in situ*.

Considered together, these field studies offered meaningful substantiation of a general account of team click in a real-world group exercise setting (H1). In addition, there was also encouraging evidence to suggest that positive expectation violation may be responsible for generating feelings of team click (but perhaps not social bonding; H2). In sum, these results suggest that team click may explain a relationship between group exercise and social bonding. In essence, successful coordination in joint action typical of group exercise can be a visceral and agentic source of social connection (Marsh et al., 2009).

8.3 Contributions to scientific understandings of group exercise

In this section, I consider the relevance of a general account of team click to existing theories of group exercise and social bonding, as well as the implications of team click—and its proposed dynamical underpinnings—for cognitive and evolutionary approaches to human sociality more broadly. First, I suggest that team click can serve as a complement to existing accounts of group exercise and social bonding, by helping explain the fleeting and dynamical dimensions to the bonding effects of group exercise. Second, I suggest that dynamical approaches to the social cognition of joint action could enhance evolutionary understandings of processes such as social cohesion and cultural evolution (Research Question 4, see Chapter 1.5.1).

8.3.1 Group exercise and social bonding

The account of team click in group exercise developed in this thesis offers a dynamical compliment to existing accounts of group exercise and social bonding. Generally speaking, existing accounts hypothesise the operation of discrete proximate mechanisms that generate social bonding (see Chapter 1.3.4). It is possible that, if properly developed and substantiated, a theory of team click in group exercise could offer a second-order framework for understanding how already-identified component mechanisms of bonding in group exercise are subject to dynamics of uncertainty and coordination in real-world settings.

Anthropologist Harvey Whitehouse has termed a general cognitive and evolutionary approach to understanding human cultural practices (group exercise, in this case), as one of “fractionating” elements of the category of interest in order to see how they independently affect social bonding (Whitehouse et al., 2014, p. 2). Existing theories of social bonding in group exercise identify links between group exercise and social bonding by hypothesising the activity of discrete cognitive and physiological mechanisms, such as neuropharmacological reward (as a result of either behavioural synchrony; see Dunbar & Shultz, 2010; Tarr et al., 2014) or physiological exertion (Cohen et al., 2009; Davis et al., 2015). Researchers have also proposed that mechanisms associated with pain (Bastian, Jetten, & Stewart, 2012; Xygalatas et al., 2013), autonomic arousal (Swann, Gómez, Huici, Morales, & Hixon, 2010), and down-regulation of cortical processing (Dietrich & McDaniel, 2004; Slingerland, 2014) could be associated with bonding effects in group exercise contexts. While a fractionating approach has (and will continue to) contribute to the development of an increasingly granular picture of the component mechanisms of social bonding in group exercise, pure fractionation alone will be less able to account for the “mystery” of phenomena such as the fleeting and delicate achievement of peak team performance (see Chapter 4.4.2).

As proposed in this thesis, team click is a phenomenon that cannot be explained by appeal to one fractionated element alone. Instead, team click appears to depend crucially on the coordination of various neurological, physiological, and social mechanisms as a response to uncertainty. Here, I suggest that a general account of team click can complement existing fractionated elements of social bonding in group exercise, by offering a theory of how—i.e., under what circumstances—these elements coordinate to produce the observable quantities of behaviour and experience in joint action.

In other words, not one discrete mechanism alone (e.g., “endorphins”), or even an aggregation of several discrete mechanisms (e.g., “endorphins plus mirror neurons”) can satisfactorily account for the empirical phenomenon of team click. What is needed, in addition to fractionation of discrete elements of the relationship, is

an explanation for how these mechanisms *coordinate* to produce assemblages of action, perception, and experience (Kelso et al., 2013). From one day to the next, athletes, music makers, soldiers, or participants in costly ritual practices perform quantitatively similar activities in which they physically (and socially) exert and synchronise. But, existing anecdotal and ethnographic evidence suggests that despite best collective efforts and intensions, for some distinct and hitherto unexplained reason, it is not guaranteed that performance of joint action in group exercise will necessarily engender positive psychological processes characteristic of social bonding (e.g., King & de Rond, 2011). Here, I propose that an explanation of the mystery of fleeting collective performance, team click, and social bonding in joint action requires a second-order explanatory framework that can explain how constituent physiological, neurological, psychological, and sociological mechanisms coordinate to generate quality (and not just quantity) of performance in joint action. A more developed and empirically substantiated account of team click can offer such a framework for social bonding in group exercise.

The behavioural synchrony and social bonding literature offers an example of the complementarity between team click and existing theories of group exercise and social bonding. It has been reliably shown in experimental settings that behavioural synchrony—defined as time- and phase-locked matching of physical movement—reliably facilitates social bonding (Launay et al., 2016), prosociality (Kirschner & Tomasello, 2010), and cooperation (Reddish, Fischer, & Bulbulia, 2013). But, there is also accumulating evidence to suggest that the dynamical properties of physical coordination in joint action may bear upon social outcomes in important ways unaccounted for in the synchrony literature (Fusaroli et al., 2014).

Analysis of naturalistic joint action scenarios reveals that overt time- and phase-locked matching of movement is often complemented by coordination dynamics that may crucially modulate synchrony's social effects. November and Keller (2014:8) explain that synchrony often serves to occlude the dynamical complexity of joint action:

..most actions performed by humans consist of a series of different elements that can be combined in a potentially infinite number of ways (similarly to morphemes composing a word or words forming a sentence), and...it is the combination of these elements, and the context in which they are produced, that determine their meaning.

Highly skilled and multilayered joint action of the kind examined in this dissertation is characterised by the need not only for correct timing (as in strict behavioural synchrony), but also for the correct movement sequencing (Palmer & Pfordresher, 2003). Predicting the structure and sequence of actions from an infinite number of possibilities calls for additional cognitive resources, such as stronger use of cortical motor areas for action simulation and representation (Bekkering et al., 2009), or lower cognitive mechanisms of movement regulation that support the emergence of functional interpersonal synergies (Riley et al., 2011).

As outlined in Chapter 2.4, joint action success may be contingent on layers of coordination that are more dynamical. Emerging research from psychology and the cognitive science of joint action has reliably shown that indicators of optimal synchronisation in real-world joint action scenarios (e.g., a music ensemble performance) rarely take the form of exact matching of behaviours. Rather, peak performance in complex joint action appears to be predicted by the existence of dynamical coupling (e.g. of postural sways of musicians) rather than more discrete measures of exact coordination between co-actors (e.g., the synchronisation of musicians with the movement of an ensemble conductor's wand (Miyata et al., 2017). In addition, there is evidence to suggest that the act of symmetry breaking appears to be just as important to interpersonal coordination as symmetry formation represented by exact behavioural synchrony (Richardson & Kallen, 2015). These dynamical cognitive processes may also involve related social effects (Marsh et al., 2009). Taken together, it appears that dynamical processes of movement regulation serve to modulate coordination in joint action at levels less appreciated by the synchrony—bonding literature (Launay et al., 2016).

As such, appreciation of the real-world (i.e., dynamical) social bonding effects of synchrony may require a dual consideration. When asking how bonding is

generated in joint action, it appears necessary to ask two questions: one concerning the componential cognitive and neuropharmacological mechanisms that are known to generate social bonding effects, and one concerning the (system) dynamics within which these componential mechanisms are enabled and constrained (Coey, Varlet, & Richardson, 2012).

Considering the second question from the perspective of the AIF, it can be predicted that the social bonding effects of behavioral synchrony for any given individual will be contingent upon whether or not that individual attends to synchrony-induced experiences as salient. In other words, the bonding effects of synchrony will be contingent not just upon whether or not synchrony is achieved, in an explicit binary sense. Instead, perceptions of synchrony in joint action can be understood in terms of a function of uncertainty, such that: higher levels of uncertainty will lead to higher salience or attention directed towards the sensory event (synchronisation of movement) under circumstances in which the unlikely event unexpectedly occurs (e.g., shock, and awe). In this sense, social connection in joint action will be underwritten not just by the achievement of exact behavioural synchrony (or exercise-induced activation of neuropharmacological reward), but by two or more co-actors occupying a shared dynamical manifold in which attention is more or less aligned. The coupling inherent in this shared dynamical space is sustained by its ability to reduce uncertainty inherent in the movement system of which each individual is a component part (Marsh2009;Riley2011;Fusaroli2014). One way to test the proposal that team click is relevant and complementary to the “synchrony—bonding” literature would be to design an experiment in which exact synchrony is held constant as perceived uncertainty in joint action varies.

8.4 Limitations and directions for future research

The general account of team click presented in this thesis is preliminary, and only provisionally substantiated. In particular, its explanatory power is limited by theoretical and methodological concerns, which I outline below. In particular, I suggest that future development of an account of team click in group exercise will

need to pay much closer attention to the operationalisation of key variables of interest, namely, uncertainty, team click, social bonding, and expectation violation.

8.4.1 Uncertainty and coordination

Uncertainty as defined in this thesis lacks rigorous development for the purposes of *in situ* behavioural research. The AIF itself is an emerging theory well-supported by mathematical formalisms and preliminary neurocomputational and clinical applications, but with very few applications to instances of human behaviour in the field (Clark, 2013). Thus, the failure of the Training Experiment (Chapter 7) to demonstrate a clear empirical link between uncertainty and joint action is not overly surprising at this early stage of application. However, the reasons for a null result in relation to the uncertainty manipulation are more fundamental than a question of research logistics and location, and future studies must carefully consider how uncertainty can be operationalised in context.

In experimental research, uncertainty has been aroused either via the introduction of time-pressure and novel learning requirements on cognitive decision-making (see: Daw et al., 2005; Körding & Wolpert, 2006), or the threat of impending pain (e.g., Voigt et al., 1990; Moutoussis et al., 2014). In the case of pain stimuli in particular, these manipulations are immediate and consequential to the individual's goals and experiences. As discussed in the discussion of the Training Experiment (see Chapter 7.6), it is highly likely that the uncertainty manipulation failed due to a lack of believability and consequentiality of the experimental prime. Many well-known psychological effects, such as the placebo effect, or the minimal group paradigm (Liu et al., 2009, p. 586), and even cognitive dissonance paradigm (Kenworthy, Miller, Collins, Read, & Earleywine, 2011), have proven famously difficult to evoke experimentally, particularly in initial stages of paradigm development.¹

¹See, for example, a fascinating interview in which Elliot Aronson reflects on his time working under Leon Festinger at Stanford University during the initial development of experimental paradigms designed to measure cognitive dissonance. Successfully arousing dissonance required both authentic performance and considerable consequentiality (i.e., monetary incentives; see <https://www.psychologicalscience.org/video/elliott-aronson-itps.html>).

Ethnographic research presented in this thesis suggested that performance-related anxiety and social guilt were experienced primarily through reference to authoritative figures such as the coach or senior players (see Chapter 4.4.2.1). Perhaps framing uncertainty in terms of a relational mode of social cognition may have been necessary to effectively arouse an effect in the case of Chinese rugby players. This proposal is consistent with cognitive dissonance literature, which suggests that cognitive dissonance is aroused in East Asian contexts only when interpersonal relationships are made salient (Hoshino-Browne et al., 2005). As discussed in Chapter 4.5, these considerations raise the issue of social processes confounding physical processes. For example, if a coach were present at each experimental session of the Training Experiment, how could it be inferred that perceived uncertainty was driven by the effects of physical movement coordination, and not just by the demand characteristics associated with the social pressure of the coach. Is it possible to disentangle the dynamical relationship between physical and social processes in response to uncertainty? Future research must grapple with this question in order to make empirical progress.

8.4.2 Team Click

A general account of team click will of course demand greater attention to its core construct. In particular, I identified team click as entailing two dimensions of experience, one pertaining to the visceral recognition of coordination in joint action, and another pertaining to the feelings of social agency through joint action. As formulated in this thesis, team click represents a “rough and ready” first attempt at operationalising extremely novel theoretical principles (AIF) and relatively limited anecdotal and ethnographic observations. Closer scrutiny of the dimensionality of team click and the proposed mechanisms that underpin each dimension will enhance the explanatory power of the construct.

8.4.2.1 Viscerality

I identified and measured three components of viscerality (tacit understanding (*moqi*), team aura, and flow or coherence in joint action), and proposed that these components could be understood in terms of the way in which uncertainty in joint action bears upon processes of “Bayesian multisensory integration” (Ernst & Bühlhoff, 2004). The role of visceral signals in shaping human cognition and behaviour is being increasingly recognised, particularly in the fields of autonomic psychophysiology, feeding and metabolism, osmoregulation, and psychoneuroimmunology (see: Critchley & Harrison, 2013). Recent findings suggesting an extensive bi-directional relationship between the central nervous system and the body’s viscera known as “neurovisceral integration” (the gut-brain axis; see Carabotti, Scirocco, Maselli, & Severi, 2015) has numerous implications for psycho-physiological health and wellbeing (Porges, 2009), and has recently been applied to the domain of social interaction (see: Porges, 2001; Van Kleef et al., 2008; Akinola & Mendes, 2014). Deeper insights into the social function of neurovisceral processes will help inform and develop the contours of viscerality that underpin perceptions of peak team performance. In particular, studies that specifically investigate the relationship between multisensory integration and neurovisceral processes could help shed light on this dimension of team click.

8.4.2.2 Social agency

I identified social agency in team click as involving perceptions of extension of individual agency by the contribution of others to joint action, and the perception of reliability of self and others in joint action. I identified processes of sensory attenuation and second-order precision-weighting as relevant mechanisms to the sense of agency in joint action. As discussed in Chapter 2.4.4, research detailing the sense of joint agency is scant compared to research pertaining to ascriptions of individual agency. Emerging research investigating the distinction between I- and we-mode cognition (Gallotti & Frith, 2013; van der Wel, 2015; Noy et al., 2017) will provide a theory of team click with valuable empirical learnings. To date,

however, most research produced on we-mode cognition and dynamical joint action more generally utilise models that are dyadic in structure, and usually involve a turn-taking sequence (Friston & Frith, 2015a; Pesquita et al., 2017). Group exercise contexts pose a challenge to these models, as they invariably involve multiple agents acting contemporaneously. To fully capture the empirical phenomenon of social agency in team click, testable models of joint action (and agency) involving two or more co-actors engaged in dynamical, co-occurring action are required.

8.4.2.3 Precedents and antecedents to team click

Future research will need to more clearly delineate the construct of team click from its precedents and antecedents. In this thesis I identified and tested the role of one possible precedent—positive expectation violations concerning team performance—and one potential antecedent—social bonding—to team click.

Positive expectation violation

The preceding role of positive expectation violation requires more detailed development. Failure of both field studies to show evidence for a relationship between positive expectation violation and social bonding supports the interpretation that positive expectation violation may be more relevant to team click directly, as a mechanism that directs attention to the visceral and agentic experiences of team click (Chetverikov & Kristjánsson, 2016). This result was contrasted by the finding in the Tournament Study, that perceptions of team performance did directly explain variance in social bonding, in both Post-Tournament and Pre- to Post-Tournament data sets. These results suggests that while expectation violation in joint action might be an important factor in generating feelings of team click, it might not be a strong enough mechanism to drive social bonding directly.

However, the reasons for this result may be in part due to study design and issues of measurement. Team Performance Components was a factor made up of four items, each of which require detailed reflection on the experience of four different aspects of team coordination. Team Performance Components may have more powerfully tapped into the implicit mechanisms involved in coordinated joint

action, encouraging athletes to reflect on coordination with specific co-actors, and, as such, the opportunity to rehearse and reinforce feelings of trust, reliability, and cooperation (Reddish, Bulbulia, & Fischer, 2013). By contrast, Team Performance Vs Expectations was only a single-item measure, the central tendency for which was well above the mid-point of the scale (i.e., on average athletes reported team performance that was better, rather than worse than expected).

It is also possible that expectation violation in joint action might not be immediately available to athlete perception or reflection. As van der Wel et al. (2012, p. 1277) point out in a discussion of perceptions of shared agency, there is evidence to suggest that sensorimotor prediction errors may be functionally de-coupled from higher-order processes of awareness in action and perception. In essence, dynamic joint action may implicate cognitive processes that exist largely below the surface of conscious awareness. The relationship between unconscious informational transfer rooted in physical movement coordination, and higher order conscious recognition of these sensorimotor referents, is still not clearly understood (Semin & Cacioppo, 2008; Frith, 2007; Frith & Frith, 2010; Clark, 2013). Thus, the use of a single-item self report of perceptions of performance relative to prior expectations may not have been rich enough to capture the full dimensionality of the experience of positive expectation violation concerning team performance. The four item factor of Team Performance Components may have more effectively preserved more variance relevant to social bonding.

Social bonding

Team click correlated highly with social bonding in the Post-Tournament, Overall Tournament, and Post-Drill (Training Experiment) data sets (see Table 8.1). While these correlations were considered high relative to the suggested threshold of .70 for multicollinearity (Field et al., 2012), high correlation between team click and social bonding was expected based on analysis of interview data. When asked specifically about on-field team click, many athletes immediately ventured into more social territory, and very rarely produced detailed technical explanations for on-field

team performance athletes automatically drew upon off-field social explanations for on-field team performance. The high correlations reported in this study between team click and social bonding do, however, raise the issue of how team click can be better isolated as a psychological construct from its precedent and antecedent mechanisms for the purposes of experimental analysis.

Table 8.1: Correlations between team click and social bonding in the National Tournament and Training Experiment studies

Data Set	Correlation
<i>National Tournament</i>	
Post	0.65
Pre-Post	0.37
Overall	0.75
<i>Training</i>	
Post-Drill	0.79
Pre-Post	0.44

The hypothesised relationship between team click and social bonding (H1b) also requires more development. It was hypothesised that feelings of team click would set a sensorimotor foundation that would facilitate—or, more accurately, demand—more elaborate representations of group identification characteristic of social bonding (Pezzulo, 2014). This hypothesis motivated the Prediction 3.b of the Training Experiment that higher levels of perceive team click to the immediate training group would generate higher levels of social bonding to the broader category of the Provincial team. Results of the Post-Drill analysis supported this prediction. However, analysis of the Pre- to Post-Drill data set did not reveal any signs that increased perceptions of team click predicted increase perceptions of social bonding. As referenced in Chapter 2.4.4.3, one previous study has proposed a link between autonomic arousal and identity fusion, whereby short bouts of physical exercise performed as a group lead to higher levels of identification with the national identity of Spain, measured by contributions to a public goods game (Swann, Gómez, Dovidio, et al., 2010, p. 824). Further research investigating the

link between physical movement coordination and social inferences characteristic of social bonding is needed.

In sum, enriching understandings of team click's internal dimensions, and disentangling team click from its precedents and antecedents will be an important project for future experimental research on team click or related concepts.

8.5 Implications of team click for applied fields

Understanding the dynamics of coordination that underwrite social bonding in group exercise can have implications for a wide range of applied contexts, including competitive sport, psychosocial health, education settings, and artificial intelligence. This thesis sought specifically to develop a novel theoretical account of team click. As such, theoretical formulations and results are both preliminary, and not suitably translated to applied fields.

8.6 Final Remarks

This thesis began with the mystery of joint action, as articulated by my friend Adrian. Since, I have suggested a mechanism through which this mystery can be empirically tested. This thesis progressed in a step-wise manner to formulate, situate, assess, and test claims of a general account of team click in group exercise. Findings from ethnographic research and field experiments substantiated the core hypothesis that team click mediates a relationship between positive perceptions of team performance and social bonding. Positive expectation violation also significantly predicted team click, suggesting that the visceral and socially agentic dimensions of team click may be experienced when successful coordination with others occurs unexpectedly. The relationship between uncertainty and coordination in joint action remains an open question, however.

Theoretical synthesis and empirical results presented in this thesis require ongoing consideration. In particular, the future research must address both the distinctiveness of team click as a construct, as well as methods through which this

construct can be reliably tested. In this thesis, I demonstrated that testing team click required first considering the construct *in situ*. Future research will need to deal more directly with the dynamical nature of team click and its underpinnings, in particular how to quantify team click in real-world settings.

I propose that team click can serve as a complement to existing theories of group exercise and social bonding, by offering a second-order framework within which more fractionated component mechanisms of group exercise can be understood to coordinate. Beyond team click, dynamical approaches to cognition and evolution are gaining traction owing to their ability to shed light on the complexity of biological life (Ramstead et al., 2017; Badcock, 2012). Team click offers an explanation for why when we move together, we do not always bond together. This thesis substantiates the claim that we bond together when the team clicks.

Appendices

and others remaining on the ground to track the hunt and intercept a fleeing target if the opportunity arises.

The evolutionary function of group hunting in Chimpanzees may not be limited to a nutritional shortfall hypothesis (which suggests that chimpanzees hunt to compensate for seasonal shortages in food availability). A second hypothesis argues that male chimpanzees hunt to obtain meat that they swap for matings (Stanford et al., 1994). A third hypothesis proposes that males use meat as a social tool to develop and maintain alliances with other males (Mitani & Watts, 2001).

A.2 Neurobiological reward in exercise

A series of laboratory studies involving human and non-human subjects exercising on stationary exercise equipment (treadmills, watt bikes) show that sustained aerobic exercise at a moderate intensity ($\sim 70 - 85\%$ of maximum heart rate)—but not low ($\sim 45\%$) or high ($\sim 90\%$) intensities—induces activity in the endocannabinoid (eCB) system (Raichlen et al., 2013), and similar results have been obtained in studies on the opioidergic system (Boecker et al., 2008). Endocannabinoids appear to play an influential role in exercise-specific neurobiological reward, with studies showing activation eCB activation in moderately intense exercise and in cursorial mammals, such as humans and dogs (but not non-cursorial mammals, e.g., ferrets; Raichlen et al., 2012). In addition to direct peripheral (analgesic) and central (psychological well-being and alteration) effects, eCBs are responsible for activating “traditional” neurotransmitters (opioids, dopamine, and serotonin), which reward and reinforce behaviour (Sparling, Giuffrida, Piomelli, Rosskopf, & Dietrich, 2003). These findings lead Raichlen to propose eCBs as a key neurobiological substrate responsible for motivating habitual engagement in aerobic exercise, by generating “appetitive” and hedonic associations with exercise behaviour (Raichlen et al., 2012).



Appendix: Introduction

A.1 Group hunting in Chimpanzees

Group hunting has been well documented in various geographically distinct populations of Chimpanzees (i.e. by Goodall (1986) in Gombe national park, by Uehara (1997) in Mahale Mountains National Park, and by Boesch and Boesch (1989), Boesch (1994) in the Tai National Park in Ivory Coast West Africa. This triangulation of observations suggests a species-wide capacity for elaborate coordination combined with bouts of intense physiological exertion. Observational studies suggest that the size and membership of hunting parties vary greatly, from a single chimpanzee to as many as 35 (Stanford, Wallis, Mpongo, & Goodall, 1994). In addition, hunting frequency appears to covary with fluctuations in group size (and particularly number of sexually receptive females in the group; see Stanford, 1996). Observational studies suggest that the size and membership of hunting parties vary greatly, from a single chimpanzee to as many as 35 (Stanford et al., 1994): Typically, a group first gathers and then simultaneously fans out in search for a victim while reducing the chances of detection by avoiding vocalisations and using slow and careful steps to minimise noise (Boesch & Boesch, 1989; Mitani & Watts, 2001). There is also a division of labor based on roles that was characterized by Boesch and Boesch (1989) as collaboration: a “blocker;” a “chaser;” an “ambusher;”

B

Appendix: A general account of team click in group exercise

B.1 Active inference framework

B.1.1 Predictive Coding

PC first emerged as a data processing and compression strategy in computer science (Rao & Ballard, 1999). Researchers programmed a multi-layer artificial neural network to use downwards connections to match samples of .JPEG images with successful predictions. Visual signals were processed via a hierarchical system in which each level tried to predict activity at the level below it using recurrent feedback connections. If the feedback successfully predicted the lower-level activity, no further action was required. Failure of the model to predict the visual signal resulted in tuning and revision of the model using “residual errors” derived from the discrepancy between top-down predictions and lower-level activity. Predictive coding offered a much more computationally efficient mechanism for data processing than previous alternatives, because prediction errors were the only informational novelties in the system (Clark, 2015a).

B.1.2 Motor control

Successful regulation with the environment depends on an organism’s capacity to move from its current state to a desired state. In the case of the human evolutionary niche, organismic regulation hinges largely on movement, be it physical or simulated (Wolpert, Ghahramani, & Jordan, 1995).

Theories of motor control generally agree the brain generates “forward models” that anticipate perceptual inputs and desired motor states (Pickering & Clark, 2014). The first paradigmatic theory of motor control suggested that forward models for action relied on special-purpose mechanism auxiliary to core mechanisms of perception of action (Wolpert, 1997). This hypothesis, now known as the Auxiliary Forward Model (AFM, see Pickering & Clark, 2014), relies on a dual mechanism of motor control. First, a motor command is estimated in the brain by an “inverse model,” which contains as its inputs both the desired state and the actual state of the organism (e.g., the position of the body, see Figure B.1). When the motor command is generated, an auxiliary copy (i.e., an “efference copy”) is also generated, and is sent to a forward model which then generates predictions about action and perception by simulating the musculoskeletal system and contextual environment (Wolpert et al., 1995; Blakemore, Goodbody, & Wolpert, 1998; Flanagan & Johansson, 2003). Prediction error arising from a discrepancy between predicted and resultant sensory inputs are then used as feedback to inform the generation of the next motor command in the inverse model, and so on in a loop, until the fit between sensory prediction and input is sharpened.

A more recent alternative proposal to the AFM suggests that forward models, instead of being auxiliary to, may instead lie at the heart of all forms of perception and action (Friston, 2010). In contrast to AFM, the “Integrative Forward Models” account of motor control (IFM, see Pickering & Clark, 2014) posits that predictions from forward models act directly as action commands. There is no dedicated mechanism used to predict the outcomes of our own (or others’) actions in addition to the action commands themselves. Instead, generative action-oriented models are treated as the actual state of affairs, and cause a cascade of downward predictions

about what should be the state of the models in the levels below (see Figure B.2). In the IFM approach, there is no need for a motor command or efference copy at each level of action prediction, and prediction errors directly update the action models themselves.

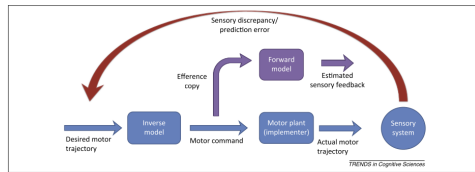


Figure B.1: The Auxiliary Forward Model of motor control

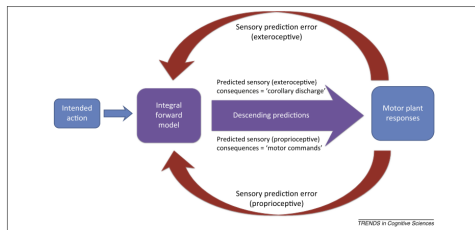


Figure B.2: The Integrated Forward Model of motor control

Both the AFM and IFM approaches agree that prediction, error minimisation, and hierarchical modelling are core processes in human cognition. From a thermodynamic standpoint, however, IFM appears to offer a more efficient model for free energy minimisation. By replacing motor commands with direct predictions about proprioceptive and exteroceptive consequences, the need for a distinct optimal control calculation (i.e. an inverse model) disappears and along with it the need for an efference copy of the motor command, thus implicitly minimising various energetic costs (Pickering & Clark, 2014; Friston, 2010). In place of the auxiliary mechanisms of the AFM, IFM posit a more complex (distributed) forward model mapping prior beliefs about desired trajectories to sensory consequences. Whereas

the “heavy lifting” in AFM required the use of an efference copy and inverse models, in IFM this work is done by the acquisition and use of a more complex predictive (generative) model (Pickering & Clark, 2014).

B.1.2.1 AFM approach to joint action

Keller, Novembre, and Loehr (2016), for example, presented a conceptual framework that applies an “auxiliary forward model” (AFM) approach to musical joint actions. The AFM approach requires that agents produce models responsible for 1) individual action planning and control (self-internal models), 2) prediction of others’ actions (other-internal models), and 3) representation of the shared goal (joint-internal models). Of these three types of models, however, only self-internal models comprise the auxiliary predictive architecture (i.e., the forward model containing an efference copy of one’s own action, and “inverse models” that are responsible for output of motor commands. Thus, both anticipation and compensation in joint action depends on a control loop, whereby sensory information (error signals) are routed (fed-back) through self-internal models, which inform the production of auxiliary predictions—of self, other, and joint action—grounded in individual motor simulations. Importantly, in this model, error signals are fed-back only to the self-inverse model, as no inverse model for the joint action partner exists.

The now longstanding proposal that individuals only produce auxiliary predictive models of their own actions (as opposed to others’ actions too) has served to explain how individuals effectively attend to others in joint action. With privileged access to an efferent copy of impending individual action, an agent is able to preemptively attenuate sensitivity to their own action, in order to attend to the actions (and prediction errors) of others (Wolpert & Kawato, 1998). For example, the AFM approach provides an explanation for the phenomenon of tickling, or specifically why it is near impossible to tickle oneself (due to sensory attenuation resulting from the self-generated predictions about the consequences of action Blakemore & Frith, 2003). However, while the AFM has proven adequate to explain individual

motor control, and some instances of joint action (such as tickling), it also contains potential shortcomings when applied to dynamical joint action scenarios.

Pesquita et al. (2017) summarise three shortcomings of an AFM approach to joint action. First, the AFM model assumes a static and unchanging representation of the shared goal and the other’s goal, and provides no mechanism through which the shared goal representation can be dynamically updated (based on prediction error signals). This issue limits the ability of AFM to account for the real-world flexibility and interchangeability of shared goals (for example, the adaptive switching between the shared goal of carrying a table or the bench depending on the location of both objects). Second, the same rigidity applies to other-inverse models. The inability to directly and dynamically update other-models suggests the practical possibility that self and other models may gradually diverge over time due to the lack of sufficient predictive information regarding the actions of others (Pickering & Clark, 2014). Third, the AFM approach does not specify how sensory input is differentially used to update self and other models, which limits the model’s ability to account for learning and adaptation within joint action (Pesquita et al., 2017). Thus, not only does the AFM approach appear to be computationally intensive (due to the recruitment of auxiliary inverse models and dual motor commands, it also appears to be unable to fully account for the dynamic interactive flexibility required of agents in real-world joint action.

Precision-weighting self- and others

In place of auxiliary processes of prediction, the AIF for joint action hinges instead on precision weighting of prediction errors in order to facilitate and finesse joint action (Friston & Frith, 2015a, 2015b). When engaged in joint action, the individual turns down the volume (reduce the precision weighting) on prediction errors relating to one’s own action so that movement can occur unimpeded by over-attention to self-generated prediction errors (an intuitive example of the opposite of this ideal scenario is a Skype call in which the flow of an individual’s speech is interrupted by auditory feedback from the other receiver’s device (feedback that would otherwise

be attenuated by the speaker), see Friston & Frith, 2015a). Alternatively, when attending the the action of others, the attenuation of proprioceptive error signals can cease. In this way, precision weighting is used to flexibly adjust the volume of multi-modal prediction errors (exteroceptive, interoceptive, and proprioceptive) in order to finesse and sustain generalised synchronisation—the shared narrative on which joint action is sustained).

Heuristically, this suggests that active inference in joint action takes one of two modes; a “sensory” mode in which an agent flexibly attends to sensory inputs, or an “active” mode in which agents act and attenuate proprioception accordingly (Friston & Frith, 2015a). To explain ticklishness, for example, the AIF can appeal to the “sensory” inferential mode in which the volume on proprioceptive prediction error is “dialled-up.” The failure of self-tickling, by contrast, can be explained as the product of an active mode of inference in joint action, in which the volume of proprioceptive prediction is “dialled-down” to enable smooth flow of action execution.¹ Thus, the AIF approach to joint action depicts two or more brains constrained by dynamic coupling (general synchronisation), which model the sensory and perceptual predictions pertaining to the movement of self and others (Pesquita et al., 2017).

¹Recall also that instances of tickling commonly involve a stationary victim. While it indeed appears almost impossible to tickle oneself, it is also rare to be tickled while moving, i.e., acting during periods of sensory attenuation.



Appendix: Research Setting

C.1 Qualifications of the researcher

Before arriving in Beijing in 2015 to begin my doctoral research, the last time I was in China was two years earlier in 2013, when I spent eight months coaching the Chinese men's youth rugby 7s team in the lead up to the Nanjing Asian Youth Olympics. Before that, I had spent one year studying on exchange at Beijing University in 2008, and another year before that on an intensive Chinese language course at Liaoning University, Shenyang, in 2006—my first trip to China. Rugby featured heavily in both instances. In 2006, an Australian classmate and friend Ed had caught wind of the fact that there was a rugby program down the road from Liaoning University at the Shenyang Sports College (SSC). Despite the fact that we had both been diligently attending class and courageously deploying our elementary Chinese to order food at restaurants and befriend local taxi drivers, Ed and I were, nonetheless, three months into our intensive language exchange and feeling that our Chinese skills were floundering. We suspected that this was in large part due to the fact that we had met very few local Chinese people our age. So one afternoon we rode our bikes over to the Shenyang Sports College in time for the rugby team's afternoon training session. Less than six months later, we were boarding an overnight train from Shenyang to Shanghai with the SSC rugby team

to compete in the annual Shanghai Rugby 7s Tournament. We had become closely integrated into the community of rugby athletes at SSC, due in part to the common language of rugby that we all shared, and perhaps mostly due to the overwhelming hospitality of the SSC athletes and coaches. The decision to find the rugby team may have also helped us improve our Chinese. Ed and I were the only two in our cohort to finish the year in Shenyang with a Level 6 in the Chinese Proficiency Exam, which qualified us to study alongside Chinese local students at an undergraduate level.

Buoyed by this experience with the SSC rugby team in 2006, I followed a similar template two years later when I arrived at Beijing University on exchange from Sydney University to study sociology at Beijing University. I had just finished working at the 2008 Beijing Olympics. At that time in Beijing, the only Chinese rugby program was based at the Chinese Agricultural University, a forty minute cycle north of Beijing University. The CAU rugby program was the strongest in the country: CAU consistently outperformed its rivals at the time (Shanghai Sports Institute, the People's Liberation Army, and SSC) and it was awarded with the responsibility of hosting the Chinese national team. When the International Olympic Committee announced in late 2009 that rugby would be played in the 2016 Rio De Janeiro Olympics, it was subsequently decided in 2010 that rugby would be inducted into the state sponsored sports system and played in the next Chinese National Games in 2013. Following this announcement, many of CAU's athletes and coaches dispersed to various professional provincial rugby programs, the main ones being Beijing and Shandong.

Between 2009 and 2013 I returned to Australia to finish my undergraduate degree, during which time my own rugby career also rapidly developed. After a successful season in the Sydney Premiership competition in 2009, I was selected to play for the Australian Rugby Sevens Team. I represented Australia from 2009 through to the end of 2012. In 2013, during the 9 month gap between my Australian rugby contract ending and the start of my graduate studies at Oxford University, I returned to China to coach the Chinese Youth Men's 7s program in their lead-up to the 2013 Nanjing Asian Youth Olympics. Along with a small team of Chinese

coaches and management, I coached a core group of roughly 25 athletes aged between 15 and 18 years old. We trained 6 days a week for approximately 6 months, with only occasional breaks for National holidays, or for athletes to return to their home provinces to complete compulsory exams. The program was based predominantly in Anhui province, and we travelled from Anhui to other provinces further afield to find suitable practice opportunities against provincial programs.

This combination of experience in China and expertise with rugby enabled me privileged access to this particular research setting.

C.2 Analysis of ethnographic data

As Braun and Clarke Braun and Clarke (2006, p. 10) explain, “A theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set.” Identification of recurring themes was guided by (but not limited to) the research questions and research hypotheses outlined in Chapter 2. Themes were identified on both explicit and implicit levels of the data (Boyatzis, 1998).

Thematic analysis involved three stages that unfolded in a recursive (rather than linear) fashion (Braun & Clarke, 2006). In phase one, I familiarised myself with the each data source in the corpus and tagged relevant extracts with theoretically-guided “codes.” For example, upon encountering Hongwei’s description of his position in the team in his interview transcript (cited in Chapter 2.1), I tagged this with codes such as “group membership,” “mutual support,” “emotional support,” “knowledge of team roles,” “signalling commitment to team” etc.

My coding system was thus directed by (but not limited to) pre-identified research questions rendered as open and investigative questions, i.e.,

1. How did athletes experience team performance and social bonding in joint action?
2. Did athletes experience team click? If so, what experiences were associated with team click?

3. How did athletes experience uncertainty in group exercise?
4. Did athletes experience expectation violation in group exercise?
5. Were moderator variables (such as technical competence and personality type, as well as the relationship between physiological exertion, fatigue, and injury and joint action) salient when discussing team performance, team click and social bonding?
6. How did the cultural context modulate experiences of social bonding?

For each data set, I created a data frame using Microsoft Excel (Version 14.7.1) in which research participants formed the rows, and distinct codes formed individual columns. Data extracts from interviews and field notes were imputed into the cells of this matrix, with an emphasis on including data surrounding each text extract, in order to preserve context (see Bryman, 2001).

In phase two, I sorted the different codes into potential themes and collated all the relevant coded data extracts within the identified themes and judged on the dual criteria internal homogeneity of codes within themes (coherence) and heterogeneity of codes between themes (distinction) (Patton, 1990). I then produced a master data-frame (*participants* $\times$ *themes*), in the cells of which data extracts from all data sets were included.

In phase three, I generated a definition of each theme, and a refined list of data extracts capable of representing that theme in subsequent analysis (Braun & Clarke, 2006).

C.2.1 Interviews

C.2.1.1 Script for semi-structured interviews

Introduction:

1. Brief explanation of my research
2. When was the first time you came into contact with rugby?

3. Where are you from?

4. What was your history with sport before rugby?

Family:

1. What does your family think about rugby?

2. Do they support you playing rugby?

3. Whose decision was it to start playing rugby?

4. Do they worry about you getting injured?

Perceived Costs Of Rugby:

1. Opportunity Costs: what would you be doing if you weren't here playing rugby?

2. How do you feel about the fitness requirements of rugby?

3. What is the feeling like when you're out on your feet and can't go on?

4. Injury: Have you had any major injuries?

5. What do you think is the hardest thing about rugby?

Perceived Benefits of Rugby:

1. Do the following motivate you to play rugby? (counter-balanced order)

- Education
- Your parents / Family (i.e., to make them proud/content)
- Beijing Residency
- Future Employment
- Teammates
- Earn Respect from (from society, family, friends)

- Find a partner

- Fun

- Represent Beijing

2. What is something new that you have learnt through rugby?

Team Membership:

1. What role do you play in the team?

2. What is the most important thing for you to do in your current role in the team?

Dissonance/Personal Shortcomings?

1. Have you ever felt like you have let the team down? (*neijiu* 内疚; failure to uphold obligation to another)

2. In what situations do you feel like that?

3. How do you react to those feelings?

Flow/team click:

1. Have you ever experienced the team playing extremely well together; everything clicking, like everyone on the field has a "tacit understanding" of each other (*moqi* 默契)?

2. When was this experience?

3. What did it feel like?

4. How do you think that *moqi* can be achieved?

C.2.1.2 Post-interview activities

Following semi-structured interviews, I asked each athlete to rank 10 different possible motivations for adherence to rugby from most important to least important. Possible motivations for rugby consisted of: *to gain access to education* (*jiaoyu* 教育), *to represent Beijing* (*daibiao Beijing* 代表北京), *to do Family proud* (*jiaren* 家人), *to gain respect from others* (*zunzhong* 尊重), *for (the benefit of) teammates* (*weile duiyuan* 为了队员), *for employment opportunities* (*gongzuo* 工作), *for money* (*qian* 钱), *for enjoyment* (*haowan* 好玩), *to find a partner* (*duixiang* 对象).

In addition, athletes were asked to report their 1) three closest friends in the team, 2) the three team members most willing to sacrifice on behalf of the team, and 3) three most competent athletes in the team (see Appendix C.2.1.2 for a full script). Athletes answered these questions using a pen and paper. I later collated and uploaded these responses to Evernote.

C.2.2 Surveys

I conducted a number of informal surveys designed to measure athletes' experience of joint action and group membership in training sessions.

C.2.3 Post-training surveys

I conducted informal surveys following three training sessions: 1) a session in which (predominantly junior) athletes ran an aerobic fitness test involving continuous running in a straight line “shuttle runs” at and above the aerobic threshold for approximately 30 minutes (known as the “Beep Test”), and 2) two 60-minute training sessions spread one week apart involving training scenarios that emulated high-intensity interaction and exertion of match conditions. After each of these sessions, I administered to each participating athlete via WeChat nine items selected from a validated Chinese version (Liu et al., 2012) of the Flow State Scale-2 (Jackson & Eklund, 2002). The items were selected to measure each of the nine conceptual dimensions of the flow experience: challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, total concentration on the task at hand, sense of

control, loss of self-consciousness, transformation of time, and autotelic experience (Csikszentmihalyi, 1990)). All survey items used a 7-point Likert scale. Responses were collected within one hour of activity completion, with the aim of gathering the data as close to the finish of an activity as possible, while minimising intrusion on the participants (Jackson & Eklund, 2004).

Flow Survey script

所有参加上午训练的球员请私信给我回答下面的九个问题。请不要和其他球员沟通，我想知道你们自己的感受。要是有问题可以直接问我。

状态流畅量表-2 (CFSS-2) 请根据你在刚刚结束的竞赛或活动中的体验回答下列问题。这些问题与你在刚刚完成的竞赛或活动过程中可能体验到的各种想法和感受有关。答案无对错之分。思考一下你在竞赛/活动过程中的感受，然后采用下面的等级划分回答问题。（等级划分1到7分：完全不同意1分； 完全同意7分）

1. 刚刚我的注意力完全正在进行的活动上
2. 刚刚行动似乎是自然而然发生的
3. 刚刚我不关心自己的表现如何
4. 刚刚时间似乎改变了（要么是减慢了，要么是加快了）
5. 刚刚我清楚的意识到自己想要做什么
6. 刚刚我的能力与情境的高要求相匹配
7. 刚刚我真的很享受那种体验
8. 刚刚我遇到了挑战，但我相信自己的技能能够应付这一挑战
9. 刚刚我不关心别人可能会如何评价自己

谢谢配合！

Can all athletes who participated in today's training session please respond to each of these questions in a private message. Please do not communicate with other athletes, I want to know about your own experience. If there are any questions you can ask me directly.

Please answer the following questions based on your experience in the just-concluded competition or activity. These questions relate to the various ideas and feelings you may have experience during the competition or activity you just completed. There is no right or wrong answer. Think about how you feel during the competition/activity and then grade each question using a scale of 1 to 7: Strongly disagree 1; Strongly agree 7).

1. Just now my attention was completely devoted to executing the activity
2. Just now it was as if everything was happening automatically
3. Just now I was not concerned about how I was performing
4. Just now it was as if time changed (either slowed or accelerated)
5. Just now I was clearly aware of what I wanted to achieve
6. Just now my abilities were matched to the high demands of the activity
7. Just now I was really enjoying the experience
8. Just now I experienced a challenge, but I believed that my skills could meet this challenge.
9. Just now I was not concerned with how others may be evaluating me

Thanks for your cooperation!

C.2.3.1 General survey administered at two time points (longitudinal)

I asked athletes to comment on experiences of joint action and group membership at two points in time spread three months apart. These survey items included experience of agency in the team (weak-strong), perceived role in the team (very small-very important), perceptions of individual performance (poor-good), perceptions of team performance (poor-good), training intensity (*qiangdu* 强度) (low-high) and difficulty (low-high). All survey items were measured using a 7-point Likert scale.

General Information Survey script

想一想刚过去的五周训练。你对以下的问题有什么经验感受？（等级划分1到7分：完全不同意1分；完全同意7分）

1. 这个阶段训练的强度（1分 非常小，3.5分 正常，7分 非常大）
2. 这个阶段训练的难度（1分 特别低，3.5分 正常，7分 特别高）

想一想你对个人和整个团队的表现:

1. 这个阶段你个人在训练当中的表现（1分 特别差；3.5分 正常；7分 特别好）
2. 这个阶段整体在训练当中的表现（1分 特别差；3.5分 正常；7分 特别好）
3. 这个阶段你个人在团队发挥的作用（1分 作用很小；3.5分 正常作用；7分 作用很大）
4. 这个阶段你在团队的个人力量（1分 比较小，3.5分 中等；7分 比较大）

Think about the last five weeks of training. What has been your experience of the following (grade each question using a scale of 1 to 7):

1. The intensity of training during this period (1 very low; 3.5 is normal; 7 extremely intense)

2. The difficulty of training during this period (1 very low difficulty; 3.5 normal; 7 extremely high difficulty)

Now think about your personal and team performance during this period.
How do you feel about:

1. Your overall individual performance in training (1 very poor, 3.5 normal, 7 very good)
2. The overall performance of the team (1 very poor; 3.5 normal, 7 very good)
3. The role that you personally play in the team (1 very small role; 3.5 average role; 7 very important role)
4. Your personal agency in the team (1 extremely weak; 3.5 average; 7 extremely strong)

D

Appendix: Uncertainty and coordination
at the Institute

D.1 Open scrutiny of performance

Open scrutiny of on-field joint action pervaded many off-field settings too. I was sitting in the canteen with a small group of senior athletes and Coach Shi after we had all finished eating. Senior player Lu, one of the most talkative at dinner conversations—usually about the intricacies of computer games such as *League of Legends*—was on this occasion driving a conversation about the technical abilities of certain Chinese rugby players known to the group at the table. Just as I had observed on the training field, there was in my eyes a distinct openness of discussion about the idiosyncrasies, strengths, and deficiencies of athletes, some of whom were former Beijing athletes, others were athletes from other provinces.

Former Beijing athlete Wang Shengshi, for example, received general mild acclaim for his physical physique, strength, and speed; while also being heavily scrutinised for his deficiencies in rugby's game play.¹ Eventually the discussion shifted to a direct and open discussion of Lu Zhongsheng, or Big Mouth Monkey

¹I commonly found myself in conversations with Chinese rugby coaches, athletes and enthusiasts about an athlete's quantifiable attributes such as height, weight, and non-rugby attributes (bench press, squat, 100m sprint)—attributes I personally spent very little energy on when making generating an opinion or impression about a player.

(Lu Zhongsheng). Big Mouth was an example of an athlete—who had transitioned from athletics to rugby during 2010-2013—who had extremely attractive physical and athletic attributes (height, weight, strength, speed), but who had yet to mature in his grasp of rugby-specific technical skills and intelligence during game-play.

Lu continued to drive the conversation, drawing attention to Big Mouth's inability to catch the rugby ball following a kick off by the opposition. "If you ought to train anything [as a forward], it should be catching kick offs" (你要练啥你该练踢接球!) The tone of the conversation driven by Lu was direct and critical, but appeared to me neither malicious towards Big Mouth, nor was it polite or accommodating in regards to his technical deficiencies. Importantly, the development and flow of the conversation was underwritten by Lu's authority as senior athlete. Never did I witness a public conversation at mealtime in which Lu himself, or Han Xiaolong for that matter, were the subject of scrutiny.

Towards the end of the conversation, others besides Lu began to join in on the criticism, to the point where the group began to laugh in chorus at Big Mouth as he tried desperately to defend their criticisms of his rugby ability. Finally, as this moment of public humiliation reached its crescendo, coach Shi intervened, saying "Ok ok enough, or else he will lose face!" (好了好了, 他快丢脸了!). In this instance, Shi, in his role as coach, was able to socially diffuse the pressure that had mounted on Big Mouth.² This evidence suggests that attention to coordination of physical movement may take on a form that is deeply relational (and hierarchical) in nature. In essence, attempts to regulate the uncertainty of joint action associated with rugby's joint action may involve a form of coordination in which attention is directed towards relationships (between athletes and coaches, or between junior athletes and senior athletes (rather than via a relationship between social categories of self and group, for example).

²Indeed, in my eyes, Big Mouth's kick off receipts were objectively substandard, and this message was being delivered by one of the most senior members of the group. The criticism was valid from Lu, but perhaps so too was coach Shi's decision to put an end to the criticism—to preserve Big Mouth's social standing as a senior athlete.

D.1.0.1 The entire system must be aligned

I encountered a number of instances in which it appeared that athletes perceived social coordination to extend well beyond the interplay of immediate social categories of self and the group. One example occurred the first morning I arrived back for the second major stint of ethnography in the summer of 2016.

I arrived back to a terrible incident in which some of the rugby team had been effectively poisoned accidentally by pesticide sprayed on the hedges outside their dormitory windows. A few days before I arrived back, the groundskeepers had carelessly sprayed pesticide on the hedges outside the windows of the bottom-floor dormitory rooms of which the rugby team were inhabitants. Some of the pesticide had made it in to the rooms of the athletes via open windows, and had caused a few of the athletes to develop throat irritations and coughs. Senior athlete Wei Wenxin, who replaced Han Xiaolong as team captain after Han was promoted to assistant coach following the change in head coach in January 2016), was one of the most seriously affected by the pesticide, and when I sat down with him at breakfast the first day I returned, he explained the story with deep anger and outrage. Importantly, when I asked him what was going to happen with all of this, he said to me “the Leadership will have to say something about this, we are all waiting to see how Leadership will respond.” (领导们必须要说话, 我们在看领导们怎么说). I found it interesting that Wei was so emphatic about the primary role Leadership ought to play in adjudicating this matter. The role of political leadership in an organisation such as the Institute was no doubt crucially important to manage such issues, but the fact that Wei was so emotional and emphatic about this fact—almost as if the Leadership had a paternal role to play—was revealing of the emphasis Wei placed on the need for alignment between levels of the social system in which he was situated.

My close interactions with the coaching staff confirmed the importance of hierarchical interdependence. During my second extended period of ethnographic research I shared a dormitory room with head Coach Wang’s offside, assistant coach Zhu Jing. Zhu Jing had recently arrived from the rugby program at Xingjiang

province, after Wang invited Zhu to join him as assistant coach. Wang needed Zhu for support: to be his loyal lieutenant, and to lighten the load on player-coaches Han and Lu. Despite transitioning to the official position of coach, Han and Lu were still required to train and play, at least until the National Games in 2017.

Zhu Jing was a new arrival to the team, and was thus on unstable ground. At the time he had no official contractual relationship with the Institute, and his position was therefore tenuous and contingent on his relationship with head coach Wang. Zhu was neither a particularly celebrated rugby player during his time as an athlete at CAU, nor was he a particularly experienced or successful coach. What he did possess, however, was a close relationship to Wang (they were classmates at CAU). Zhu was valuable to Wang for his loyalty—useful to Wang in his attempt to stabilise his leadership of the team—an inherently slippery platform for social activity. In terms of his value to the team as a rugby coach and the Institute, however, Zhu still had much to prove.

If I were in his position, I thought, I would have done everything possible to help head coach Wang and the team—understood as a category demarcating the athletes and coaches only—to improve performance. As part of this, no doubt, I would seek to signal diligence and commitment in the way I went about my business as a coach. After about two or three weeks into our roommate relationship, it became clear to me that Zhu Jing was not so concerned with signalling diligence, at least not to me, and not to the athletes either, at least not in a way that I personally recognised.

Most mornings I would wake up at 7:15am to attend breakfast with the athletes and then collate my field notes and prepare for morning training, starting at 9:00am. Zhu, on the other hand, would reliably sleep through until roughly 8:50am each morning, and then turn up to training usually at around 9:20am after athletes had completed their warm up. After lunch, Zhu would return to bed, usually from 1:30pm until 3:00pm, depending on when afternoon training was scheduled.³ I rarely witnessed Zhu spend any time working on preparing training schedules or other forms of professional development.

³Afternoon siestas are admittedly an institutional in China’s work life, but routine indulgence in a two-hour nap was surely taking the institution to its extreme.

As it turned out, head coach Wang also began to notice the way in which Zhu was approaching to his job, and decided to broach the issue with him. After the final Tournament in Qian An in July 2016, the team went out together for dinner. This dinner was much less ritualised than the first team dinner organised by Wang earlier that year. Junior athletes were in one room, and the senior athletes and coaches were in another room, free to socialise within their more naturally occurring social factions. Towards the end of the evening, after the effects of alcohol had well and truly set in, a heated discussion developed between head coach Wang and assistant coach Zhu. The discussion began with one of Wang's numerous toasts to the group at the table. Wang said that it was important that the rugby program distinguished itself as an excellent team at the Institute, and there was a need for all senior members of the team (seated at the table) to contribute to this project.

It became clear that Wang wished to emphasise the need for Zhu in particular to “lift his game” in this regard. Wang explained that as head coach he was burdened with a lot of administrative work that detracted from his ability to manage athletes and training. Given that the team was without a dedicated team manager (who would usually manage daily concerns of athletes and organise team logistics), Wang suggested that Zhu ought to improve his contribution. “As an assistant coach, you need to conduct yourself at a high standard” (当助理教练你要作为一个高度) said Wang directly to Zhu, indicating that his current standard was not acceptable. Wang spoke politely, but the public nature of these remarks suggested that he was using the opportunity to formally criticise Zhu.

Zhu retorted defiantly, directing attention away from his personal standards to the global situation of the team at the Institute. Zhu suggested that the most important thing was that the leadership of the program supported the program, and only then could the program achieve a high standard: “you have to have the support of leadership” (必须有领导的支持). Lu and Han, the next most senior team members present, also became involved in the discussion, with Lu siding more with Zhu and Han siding more with Wang.

The next morning, Zhu and I lay in our dormitory room beds, hung-over from ceremonial drinking after the team dinner the night before. Zhu revived the dinner incident with me, seeking my support for his position. Zhu insisted that his ability as an individual was fundamentally limited if the Leadership did not appear to offer him support. I was in no state to record or write down Zhu's remarks, but his message was clear. If the team does not have the faith and support from the Institute (which in this case, it clearly did not have, at least since 2013), then how was Zhu supposed to perform his role? I could see the point he was making, but the combination of my own deep-seated intuitions about ethics of group membership and self-conduct, and an unstable stomach, meant that I couldn't help but challenge Zhu on his line of reasoning, and I asked him if he thought there was anything that he should be doing better himself...

After all, I thought that the clear way to counteract lack of support from the powers above was to demonstrate self-competence, to signal diligence and willingness to move independently, despite or in spite of the level of support from leadership. As I looked at the state of the team, there were clear problems that needed addressing by someone like Zhu. In the eyes of someone with professional expertise in rugby, there was an apparent lack of clear team discipline, a lack of focus, intensity, and technical precision during training, a lack of physical fitness necessary to survive the challenges of a high level rugby tournament. These were all things within Zhu's power to address and improve, or so I thought.

But again, Zhu pushed back. He told me that he had experienced this situation before with Xinjiang Province during the last National Games. The Leadership started off being very positive about rugby, promising this and that, but then in the end, nothing came through. The support of leadership is hugely important in China: money, incentives, all of it. If you don't have support from Leadership then you can't get anywhere. Zhu was obviously defensive about the situation, attempting to deflect any blame or responsibility for his action (or lack thereof).

Perhaps Zhu's claims were not completely unreasonable in the specific environment—an environment in which hierarchical relationism was a dominant mode of social

attention. Zhu was referring in a sense to the importance of the harmony of the whole system of social relations in which he was embedded as but one node situated at but one level. Individuals can only act with agency if the relationships to which individuals attend also sanction and support that agency, Zhu was effectively suggesting. In the hierarchical system of relationships at the Institute, the crucial node in the system is the paternal benevolence of Leadership. In this dominant paradigm, social institutions of self, team, and institute do not provide resources for agency and action in and of themselves—as stable moorings of psychological and social resources (Yuki, 2003). Rather, these social categories appear to act as platforms for the fostering of particularistic relationships through which social coordination is located. In this way, Zhu’s stance mirrored the explanation I had received from Wei Wenxin a few weeks earlier, the morning I first arrived back to the Institute for my second stint of ethnography: “We are all waiting to see how Leadership will respond.”

E

Appendix: Team click in a National Tournament

E.1 Method

E.1.1 Procedure

E.1.1.1 Study Introduction Script

大家好，我是前澳大利亚国家队队员，现牛津大学博士生李杰。我在做一个调查，是关于橄榄球运动员在高水平比赛前后的感受。这项研究可能有助于提升职业橄榄球运动员在高水平比赛中的表现。请所有参加河北比赛的球员完成以下的调查。需要大约15分钟的时间完成。您所回答的问题对于我调查信息的准确性是十分重要的，所以请如实填写问卷。调查中的所有信息仅供研究使用，并对信息进行保密。有什么关于调查的问题请直接和我联系。感谢配合！调查链接：

“Hello everyone, I am former Australian 7s Representative and current Oxford University PhD candidate, Jacob Taylor (Li Jie). I am conducting a study about the experience of professional rugby players before, during and after high-level rugby competition. I hope that this research will contribute to an understanding of high-level athletic performance. Can every athlete participating in the Qianan National Tournament please complete the following survey. The survey will take about 15 minutes to complete. It is very important for the quality of the research that you answer questions honestly according to your own experiences. Survey responses are confidential and will be used for research purposes only. If you have any questions please get in touch with me. Thanks for your cooperation! Here is the survey link:”

E.1.2 Survey Items

E.1.2.1 Pre-Tournament Survey Items

Additional performance items

Performance On Mood “To what extent does the way you perform influence your mood?”

Performance Confidence Future “To what extent does your recent performance influence your confidence for future performance?” Athletes responded to each item by moving a toggle left or right from its default centre position on a continuous 100-point scale (0 = “Not at all”, 100 = “Extremely”).

Team Click

The following items were designed to measure “team click”:

Tacit Understanding: “In the past month, how strong has the tacit understanding been between team members?” “Tacit understanding” is an English translation of a Chinese term *moqi*, which is often used in team sport contexts to express the idea of “group flow” or “team click.”

Team Aura: “How is the aura in/around the team in the past month?” This question utilised the Chinese word *qichang*, a term taken from Chinese qigong, literally meaning “field of energy.” *Qichang* is commonly used to describe the atmosphere generated when the team is performing playing well.

Reliability Of Others: “During the past month, to what extent have you felt that you can rely on others to perform their roles on the field (for example, in key moments of competition or training)?” - This item was designed to measure perceived reliability of teammates to successfully coordinate on-field behaviour

Reliability For Others: “During the past month, to what extent have you felt that others can rely on you to perform your role on the field (for example, in key moments of competition or training)?” Designed to measure the perception of the surveyed athlete’s own reliability to perform on-field coordination tasks for other teammates:

Ability Extended By Others: “When coordinating with others on the field in the past month, do you feel that your individual ability is extended by the ability of your team mates?” Designed to measure the extent to which the athlete feels that his or her ability is extended or enhanced by the ability of teammates.

Click Pictorial: a novel visual item with five responses, ranging from less to more coordinated arrangements of dots (representing 12 athletes in the team). See Figure 6.1.

Social Bonding

Emotional Support “How emotionally supportive does the team feel?”

Shared Goal “How strong is the feeling that everyone is working towards a shared goal?”

Group Identification Verbal A six-item scale designed to measure an individual’s personal identification with the stereotypical features of the in-group (Mael & Ashforth, 1992). All 6 items were measured using a 5-point Likert scale.

1. When someone criticises my team, it feels like a personal insult
2. I am very interested in what others think about my team
3. When I talk about my team, I usually say “we” rather than “they”
4. This team’s successes are my successes

5. When someone praises my team, it feels like a personal compliment
6. If a story in the media criticises my team, I would feel embarrassed

1. 当有人批评我的团队，那就像是对我个人的侮辱
2. 我很好奇的团队的人民怎看我的团队。
3. 当我提到我的团队，我通常会用「我们」而不是「他们」。
4. 我的团队的成功就是我的成功
5. 当有人赞美我的团队，那就像是对我个人的夸赞
6. 当媒体播放一批我的团队的故事，我会觉得很尬

Identity Fusion Verbal A seven-item scale designed to measure an individual’s “feeling of oneness with the group” (Swann et al., 2009). Identity Fusion is differentiated from Group Identification in its ability to account for an individual’s felt, emotional and personal agentic associations with being a member of the target in-group (Swann, Jetten, Gómez, Whitehouse, & Bastian, 2012). All 7 items were measured using a 5-point Likert scale.

1. I am one with my team
2. I feel immersed in my team
3. I have a deep emotional bond with my team
4. My team is me
5. I’ll do for my team more than any of the other team members would do
6. I am strong because of my team
7. I make my team strong

1. 我和我的团队是合而为一的
2. 我感觉完全融入我的团队
3. 我对我的团队有深刻的情绪连结
4. 我的团队就是我

5. 我比任何其他人更愿意为我的团队付出
6. 我因我的团队而强壮
7. 我使得我的团队

Identity Fusion Pictorial A visual scale designed to measure Identity Fusion to the target in-group (Swann et al., 2009). The pictorial scale depicts two circles, one smaller circle to denote the individual, and one larger circle to denote the group, progressively moving closer to each other such that the most “fused” option depicts the smaller circle encased by the larger circle. The scale offers a total of five options to chose from, see Figure 6.2. A total of three pictorial scales were included, each with different target in-groups: team, family, and country (China).

Fusion Pictorial Rank Athletes were asked to rank their fusion to team, family, and country (Whitehouse et al., 2014). “Thinking about these relationships [to team, family, and country] please rank them below in order of which you feel most connected to. 1 for most connected, 3 for least connected.”

Subjective and Objective measures of technical competence

Athletes were asked about their individual technical competence: “Rate your individual ability in rugby,” relative to:

1. Other teammates currently in your team
2. Other current professional Chinese rugby players
3. Professional rugby players form other countries

Items were measured with a zero-centred 100 point scale, -50 - “Extremely weak”, 0 - “Average”, 50 - “Extremely strong”).

Athletes were asked to report rugby-related attributes that would provide a more objective indicator of technical competence. These measures included: 1) rugby training age (number of years of experience training for rugby, to the nearest

number of years), 2) the number of years spent training with the provincial teams (to the nearest year), 3) whether the athlete is a usual member of the provincial program’s starting team or the reserves.

Ten Item Personality Index

Athletes were asked to indicate on a 7-point Likert scale the extent to which they agreed with 10 pairs of adjectives as appropriate descriptions of their personality. For example: “I see myself as: dependable, self-disciplined” (Response: 1 - “Disagree strongly”, 2 - “Disagree moderately”, 3 - “Disagree a little”, 4 - “Neither agree nor disagree”, 5 - “Agree a little”, 6 - “Agree moderately”, 7 - “Agree strongly”). In the TIPI, two survey items corresponded to each of the big-five personality types, as follows:

Extraversion: 1. Extraverted, enthusiastic; 6. Reserved, quiet (Reversed scale)

Agreeableness: 2. Critical, quarrelsome (Reversed); 7. Sympathetic, warm

Conscientiousness: 3. Dependable, self-disciplined; 8. Disorganised, careless (Reversed)

Emotional Stability: 4. Anxious, easily upset (Reversed); 9. Calm, emotionally stable.

Openness to Experiences: 5. Open to new experiences, complex; 10. Conventional, uncreative (Reversed)

Injury Status

Athletes responded to a question item asking about their injury status: “Currently, are you physically able participate in a game?” (100-point scale (0 = “Unable to play”, 100 = “Completely fit to play”).

Team Discipline

Athletes were asked about their feelings regarding their team's commitment to aspects of team discipline over the past month (punctuality to training and team meetings, observing bed times and curfews, attendance at meals, general team conduct) (100 point scale for each item, 0 - "Extremely poor", 100 - "Extremely strong").

Identification Variables

In addition to the items mentioned in the main text, Athletes also reported their date of birth, team affiliation, usual playing position (forward or back), contract type, and athlete status.

E.1.2.2 Mid-Tournament Survey Items

Performance

Individual Performance Expectations "Overall, how do you feel about your individual performance in this game?"

Team Performance Expectations "Overall, how do you feel about your team's performance in this game?"

Both items used a zero-centred continuous scale, -50 = "much worse than expected", 0 = "As expected", 50 = "much better than expected".

Arousal, Exertion, and Fatigue

Following each mid-Tournament survey and in the post-Tournament survey, Athletes were asked to report on various components of physical and mental fatigue, exertion, and injury. Athletes were asked about their mood ("How are you feeling now after the tournament?") and responded by choosing a point on a 10-point scale between three pairs of emotions ("Not aroused / highly aroused", "Depressed/Relaxed" and "Nervous/Excited"). Athletes were also asked about feelings of fatigue "How fatigued do you feel as a result of the game/tournament?", perceived physical exertion (Borg

RPE scale; Borg, 1990) and perceived mental exertion using two 15-point scales (see Noakes, 2012). Athletes were also asked to indicate their injury status on a 100-point scale (0 = "Unable to play", 100 = "Completely fit to play").

E.1.2.3 Post-Tournament Survey Items

The post-Tournament survey repeated the mid-Tournament items, asking:

Individual Performance Expectations "Overall, how do you feel about your individual performance during the tournament?"

Team Performance Expectations "Overall, how do you feel about your team's performance during the tournament?"

E.1.2.4 Objective Performance Measures

Final Rank: A rank was given to each team based on performance in their respective competition (men's and women's). These rank scores were then reversed for the purposes of statistical analysis (1st place in men's Tournament (8 teams) = 8, 2nd place = 7, and so on)

Total Wins - Losses: A team's total number of losses was subtracted from its total number of wins. Thus, more successful teams overall had a higher score.

Total Minutes: Total number of minutes played throughout the Tournament by each individual athlete

Total Points: Total number of points scored throughout the Tournament by each individual athlete

Starting Team Average An average measure indicating likelihood of an athlete being selected in the starting team. Each Athlete was awarded 1 point for each game he or she started in the starting team; reserve squad athletes were awarded zero for each game. Each athlete's total was divided by the total number of games that they participated in during the Tournament, including

games in which they didn't take the field, to produce an average score for the Tournament.

E.2 Data Analysis

E.2.1 Data reduction

E.2.1.1 Exploratory Factor Analysis

EFA is one of various available data reduction techniques, and is distinct from its main alternative, Principal Components Analysis (PCA), in that it is capable of modelling the latent dimensions of a collection of variables. PCA is concerned only with establishing which components exist within the existing data and how a particular variable might contribute that component. To do this, PCA makes the assumption that all variance in a subset of variables is common variance, and therefore communality between all variables is equal to 1. From this assumption, the original data can be transposed into a linear model without the need for a communality-dependent estimated coefficient for each variable (Widaman, 2007). EFA examines all the pairwise relationships between individual variables and seeks to extract latent factors from the measured variables. Squared Multiple Correlations (which are essentially multiple regressions in which each variable is predicted by all others) were used to calculate the common variance (communality) between each variable in an analysis (the communality value is much like an R-squared value from a multiple regression). The square root of the communality score for each variable is then used as a coefficient that conditions the relationship between each variable and the underlying dimensions (factors) identifiable in the data. Also known as "factor loadings," these coefficients become the parameters of linear model capable of estimating factor scores for each individual observation, which can be utilised in subsequent statistical analysis in place of single variable observations.

A final step in the EFA procedure is the process of "rotation", which is an optimisation technique designed to encourage each variable to load on as few factors as possible (Rummel, 1988). Rotation refers to a geometric conception of factor analysis, in which individual variables can be plotted in n-dimensional space

according to their relationship to each dimension or factor (see Figure E.1 for a graphical illustration of the difference between orthogonal and oblique rotation). By rotating the axes of these dimensions, the distance of a given variable to that dimension can be reduced, which results in an increase in factor loading on one factor and (ideally) a decrease in factor loading on another uncorrelated variable. Orthogonal (or perpendicular) rotation of axes refers to axes, say X and Y, maintaining a 90-degree perpendicularity and rotating clockwise or anticlockwise, depending on the location of the variable clusters. Orthogonal rotation thus enables optimisation of loadings for clusters of variables that are distant from each other in n-dimensional space. If correlation exists between clusters of variables, however, rotating axes obliquely (inwards towards each other) provides a more effective way of reducing the distance between clusters of variables and the latent dimensions that account for such clustering (Osborne, 2015). Given that most variables of interest in the present study were correlated to some degree, I opted for an oblique rotation method (Field et al., 2012). EFAs were conducted using the `factanal()` function in the Stats package (Version 3.3.0) in R, using the "promax" (oblique) rotation method (Gorsuch, 1983). Factor scores were calculated as standardised z-scores: zero-centred, with a standard deviation of 1.

E.2.1.2 Sampling adequacy measures: KMO and Bartlett's Test for Sphericity

The KMO index provides a proportion measure of common variance to partial correlations among examined variables. If the KMO index is high (≈ 1), the EFA can act efficiently; if KMO is low (≈ 0), the proposed EFA is not suitable for analysis.

Bartlett's test of sphericity is used to test the null hypothesis that the correlation matrix is an identity matrix (i.e., a square matrix in which all the elements of the principal diagonal are equal to 1, and all other elements are 0s).

E.2.1.3 Reliability measures: Cronbach's alpha and Guttman's lambda3

Cronbach's α is a function of the number of items in a test, the average covariance between item-pairs, and the variance of the total score (Tabachnick & Fidell, 2007)

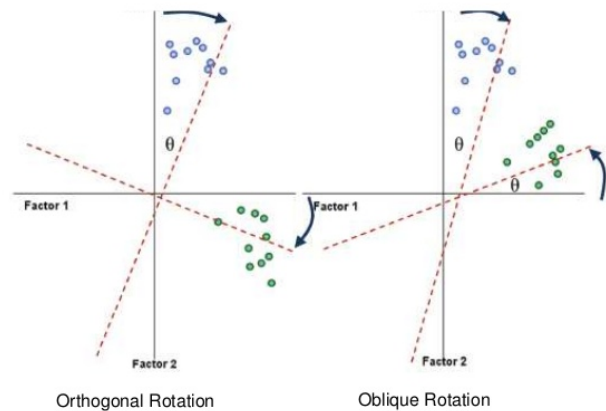


Figure E.1: Orthogonal and oblique rotation methods

E.2.2 Model Selection

Due to the dependencies in the data and missingness throughout, both traditional ANCOVA (analysis of co-variance) models linear mixed-effects regression models (LMER) are capable of incorporating both fixed and random effects into analysis of variance, however ANCOVA designs only allow the intercept (and not the regression slope) to vary according to level-2 variance, whereas LMER can model the variability of both intercept and slope across different groups of the predictor variable (Field et al., 2012). In addition, the ability of LMERS to deal with unbalanced designs (due to missing values) meant that a LMER was the most suitable modelling strategy for the present study.

E.2.2.1 Judging robustness: normality of residuals

Non-normally distributed residuals are problematic as they may influence the model's ability to generate accurate parameter estimates. Two data manipulation techniques were considered in order to normalise residuals and therefore preserve the estimates of the model: 1) exclusion of outliers (according to Tukey's method; observations above and below 1.5x the Inter Quartile Range (IQR); see Tukey, 1977) and 2) transformation of the outcome variable. Transformation of the outcome variables was the preferred method over outlier exclusion, due to the cost involved in removing observations that may be of potential theoretical relevance to the scientific investigation (Rousseeuw & Hubert, 2011).

E.2.2.2 Intra-class correlation

To assess the need for a statistical model capable of accounting for correlation of residuals, dependency in the data was quantified using a ratio measure comparing within- and between-group variance, known as the intra-class correlation (ICC). Clustering in the data according to team or sex (the separate men's and women's Tournament) was considered.

For team-level variance, a one-way random effects model was used, in which average within-team variance (Mean Square Within) of the response variable was divided by the average total variance of the response (Mean Square Total) (Field, 2005). Each athlete was member of one of 15 teams, which were considered to be sampled from a larger pool of potential teams, hence treated as random effects. The ICC was then interpreted as the percentage of total variance accounted for by group-level variables (Wolak, Fairbairn, & Paulsen, 2012). To statistically account for the unbalanced design of the data, an adjusted sample-size coefficient (k) was calculated using an equation provided by (Lessells & Boag, 1987). While there is no firm agreement on what is deemed meaningful within-group variance, an ICC ratio of $> .10 - 1.00$ with confidence intervals that do not include zero was considered an indication of non-random correlation of group-level residuals (Bailey & Byrnes, 2011). As Table E.1 and E.2 indicate, small to moderate team-level

Table E.1: Intra-Class Correlations for post-Tournament Factors according to team

	variable	ICC	Lower CI	Upper CI	k
1	Subjective Competence	.01	-.06	.19	8.48
2	Objective Competence	.36	.18	.63	8.48
3	Team Performance Components	.37	.19	.63	7.77
4	Ind Performance Components	.22	.07	.48	7.77
5	Team Click	.30	.13	.56	7.77
6	Social Bonding	.10	-.01	.32	7.77
7	Fatigue	.06\$	-.04	.26	7.77

Table E.2: Intra-Class Correlations for post-Tournament Factors according to sex

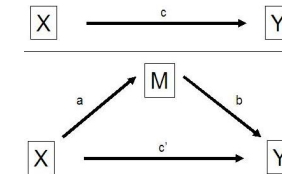
	variable	ICC	Lower CI	Upper CI	k
1	Subjective Competence	.04	-.006	.98	58.93
2	Objective Competence	.09	.006	.99	58.93
3	Team Performance Components	-.02	-.02	.01	58.39
4	Ind Performance Components	.11	.009	.99	58.39
5	Team Click	-.01	-.016	.88	58.39
6	Social Bonding	.08	.003	.99	58.39
7	Fatigue	.02	-.01	.97	58.39

intra-class correlation of responses exist for factors of Objective Competence, Team Performance Components, Individual Performance Success, and Team Click. ICCs for Social Bonding and Fatigue meanwhile were relatively low (all $r's < .1$). Sex-level ICCs were all relatively low, suggesting that sex-level variation could be ignored in subsequent inferential analyses.

E.2.2.3 Mediation Analysis

A formal mediation analysis can be used to test the prediction that the relationship between perceptions of joint action success and social bonding is mediated by feelings of team click, by analysing if and how an intervening variable is causally significant to the relationship between a predictor and an outcome variable. A variable is a mediator if it carries the influence of the predictor variable to an outcome variable, if it serves to explain (either partially or fully) the variance in the outcome variable attributable to the predictor. In the case of this analysis,

do perceptions of joint action success have an indirect effect on feelings of social bonding that is transmitted through feelings associated with team click?

**Figure E.2:** Mediation Analysis: direct and indirect effects

Mediation analysis works by testing the extent to which the variance in the outcome attributable to a predictor variable (the direct effect, or path “c”: $Y_i \sim d_Y + cX_i + e_i$) can be explained *indirectly* by the variance of two other relationships: that of the predictor variable and a third mediator ($X \rightarrow M$, or path “a”) and M and the outcome variable (path “b”), controlling for the direct relationship between X and Y (path “c”) (see Figure E.2). The mediation model can thus be denoted by two equations:

$$M_i \sim d_M + aX_i + e_{Mi} \quad (\text{E.1})$$

$$Y_i \sim d_Y + bM_i + c'X_i + e_{Yi} \quad (\text{E.2})$$

When combined, these two equations enable the calculation of the “indirect effect” of the predictor on the outcome, by controlling for the relationship between the mediator’s effect on the outcome variable as a function of its relationship to the predictor variable. While the direct effect measures the extent to which the dependent variable changes when the independent variable increases by one unit and the mediator variable remains unaltered, the indirect effect measures the extent to which the dependent variable changes when the independent variable is held

fixed and the mediator variable changes by the amount it would have changed had the independent variable increased by one unit (Bauer, Preacher, & Gil, 2006).

The multilevel structure of the data in this study, i.e. the clustering of residuals according to team affiliation, violates the independence assumption of mediation analysis. As such, traditional multiple linear regression and path analysis will produce biased tests of the effects in the mediation model (Raudenbush & Bryk, 2002). A multilevel mediation analysis must therefore additionally take into account variance attributable to the random effects of the model (team, in this case), and in so doing capture heterogeneity of variance in the indirect effect due to the level 2 variable (Tofighi & Thoemmes, 2014). To do this, each coefficient in the model must be random (denoted by subscript “j”), so that the value of the coefficient varies across Level 2 units (team):

$$M_{ij} \sim d_{Mj} + a_j X_{ij} + e_{Mij} \quad (\text{E.3})$$

$$Y_{ij} \sim d_{Yj} + b_j M_{ij} + c_j X_{ij} + e_{Yij} \quad (\text{E.4})$$

Linear mixed effects regression models are fitted according to these equations, and estimates of mediation effects can be computed from these model parameters. Subsequent mediation analyses were conducted using the “mediation” function of the Causal Mediation Analysis Package (version 4.4.5) in R.

E.3 Results

E.3.1 Descriptive Statistics

E.3.1.1 Pre-Tournament Data Descriptives

Table E.3 displays the variables relevant to an Athlete’s technical competence. These variables were collected in the pre-Tournament survey, and as such the number of observations per variable is generally 120, except for “Starting Team Average,” which

Table E.3: Summary Statistics: post-Tournament Technical Competence (objective and subjective)

Variable	n	mean	sd	min	max	skew	krtss
Years In Team	120	3.17	2.12	0	7	0.29	-1.25
Training Age	120	4.40	2.35	0	13	0.47	0.66
Starting Team Average	172	0.61	0.36	0	1	-0.43	-1.32
Age	121	21.67	3.26	16	32	0.52	-0.27
Ability Teammates	120	19.45	20.14	-40	50	-0.31	-0.56
Ability Chinese Pros	120	15.78	19.59	-35	50	-0.18	-0.65
Ability International	120	18.46	26.19	-44	50	-0.48	-0.77
Team Ability China	120	22.48	22.90	-40	50	-0.64	-0.58

was generated from the objective performance data provided by CRFA following the Tournament. The average number of years in the team was over three years, and the average training age for Athletes was 4.4 years. In terms of subjective confidence, means for each variable were well above the mid-point of the scale, suggesting that Athletes were on average quite positive about their own ability compared to other athletes (their teammates, other Chinese professionals, International professionals).

E.3.1.2 Post-Tournament Data

Table E.4: Summary Statistics: post-Tournament measures of fatigue

Variable	n	mean	sd	min	max	skew	krtss
Fatigue	118	69.27	21.24	0	100	-1.13	1.40
RPE(physical)	118	14.97	2.66	6	20	-0.80	0.49
RPE(mental)	118	6.08	2.47	-4	10	-1.13	1.82
injuryRev7	118	23.86	26.91	0	100	1.19	0.60

In addition to main variables of interest, the central tendency of distributions of responses related to arousal, exertion, and fatigue were also well above the mid-point of their respective scales (see Table E.4). Table E.5 displays athlete objective performance in the Tournament. Athletes played an average of 44 minutes of rugby during the Tournament (just under four full games each), and each Athlete

Table E.5: Summary Statistics: Objective Tournament Performance

Variable	n	mean	sd	min	max	skew	krtss
finalRank	174	4.83	2.15	1	8	-0.09	-1.17
totalWL	172	0.32	2.94	-6	6	-0.17	-0.25
pointsTotal	172	8.45	11.41	0	69	2.34	7.23
minutesTotal	172	44.01	20.65	1	81	-0.38	-0.89
startingAvg	172	0.61	0.36	0	1	-0.43	-1.32

scored an average of 8.45 points, which amounts to between one and two tries each, or a number of try drop-kick conversions (worth two points each).

E.3.2 Data Reduction

E.3.2.1 Fatigue

Post-Tournament

Post-Tournament survey items relating to perceptions of fatigue and exertion were separately analysed for the purposes of data reduction. Due to difficulty completing questions related to arousal in the online and in-person surveys, mood-related items were excluded from analysis. In addition, it was clear from correlation values that injury status did not strongly correlate with other items relevant to fatigue and exertion, and was therefore also excluded from subsequent analysis. The KMO index and Bartlett's test of sphericity indicated that the remaining subset of variables was appropriate for EFA, $KMO = 0.69$, $\chi^2(3, N = 118) = 111.93$, $p < .001$. EFA was performed on 3 remaining items (fatigue, physical perceived exertion, and mental perceived exertion), which imposed one factor labelled "Fatigue Factor." The extracted factor explained 57.8% of the overall variance (SS Loadings = 1.7, $Guttman's \lambda = .73$ and Cronbach's $\alpha = .80$).

Pre- to Post-Tournament

Three survey items related to feelings of fatigue (mental, physical exertion, and fatigue) were collected and subjected to EFA. Correlations between variables were high (all $r's > .55$, $KMO = .7$, $\chi^2(3, N = 238) = 382.88$, $p < .001$). As such,

one factor ("Fatigue Change") was imposed, which explained 66.3% of the overall variance ($SSLoading = 1.99$). $Guttman's \lambda = .8$ and $Cronbach's \alpha = .85$ indicated that the data reduction was appropriate.

Overall Tournament

Fatigue items consisted of fatigue, physical exertion and mental exertion. Correlations between variables were high, indicating that imposing one factor was appropriate (all $r's > .62$, $KMO = 0.71$, $\chi^2(3, N = 440) = 677.37$, $p < .001$). The factor imposed for fatigue, "Fatigue Tournament," explained 69% of the variance ($SSLoading = 2.07$) and $Guttman's \lambda = .82$ and Cronbach's $\alpha = .87$) indicated that the data reduction was reliable.

E.4 Analysis of study predictions

E.4.1 Prediction 1.a: Team Performance Components predicts Team Click

Table E.6: Prediction 1.a (Post-Tournament): Team Performance Components predicts Team Click (n = 97)

	Intercept	Main effect	Controls
(constant)	−0.04 (0.15)	0.02 (0.07)	−0.55 (0.37)
Team Performance Components		0.65*** (0.10)	0.66*** (0.11)
Ind Performance Components			−0.04 (0.09)
Objective Competence			0.05 (0.08)
Subjective Competence			0.11 (0.07)
Final Rank			0.03 (0.04)
Minutes Total			0.00 (0.00)
Points Total			0.00 (0.01)
Fatigue			0.10 (0.08)
Extraverted			0.03 (0.05)
AIC	299.06	237.51	211.70
BIC	307.37	254.14	247.75
Log Likelihood	−146.53	−112.76	−91.85
Num. obs.	118	118	97

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .56$, Conditional $R^2 = .61$

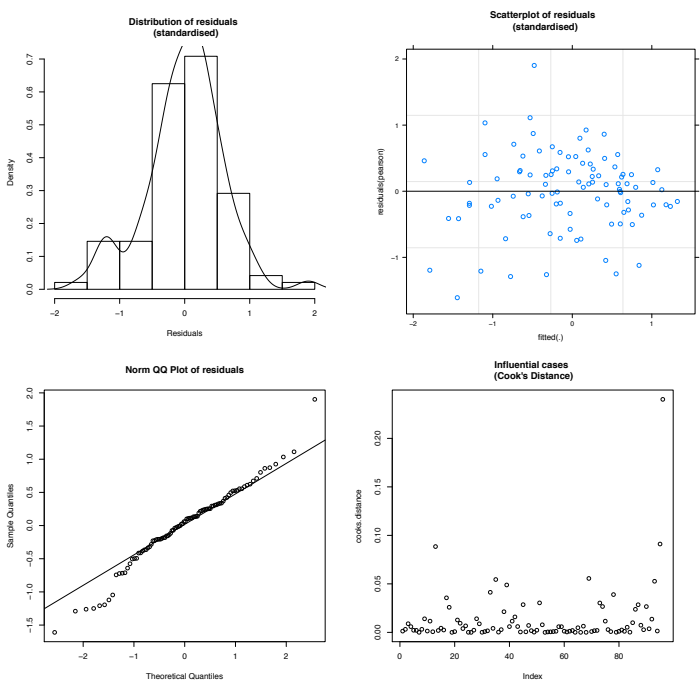


Figure E.3: Prediction 1.a Model Assumptions (Post-Tournament): Team Performance Components Predicts Team Click.

Table E.7: Prediction 1.a (Pre- to Post-Tournament): Team Performance Components Change predicts Team Click Change (n = 90)

	Intercept	Main effect	Controls
(constant)	0.10 (0.13)	0.10 (0.08)	0.01 (0.40)
Team Performance Components Change		0.47*** (0.08)	0.51*** (0.11)
Ind Performance Components Change			−0.00 (0.10)
Objective Competence			0.02 (0.10)
Subjective Competence			−0.01 (0.08)
Final Rank			−0.03 (0.04)
Minutes Total			0.01 (0.00)
Points Total			0.01 (0.01)
Fatigue			−0.12 (0.09)
Extraverted			−0.01 (0.05)
AIC	267.19	227.50	218.66
BIC	274.97	243.07	253.66
Log Likelihood	−130.59	−107.75	−95.33
Num. obs.	99	99	90
Num. groups: team	14	14	13

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .40$, Conditional $R^2 = .47$

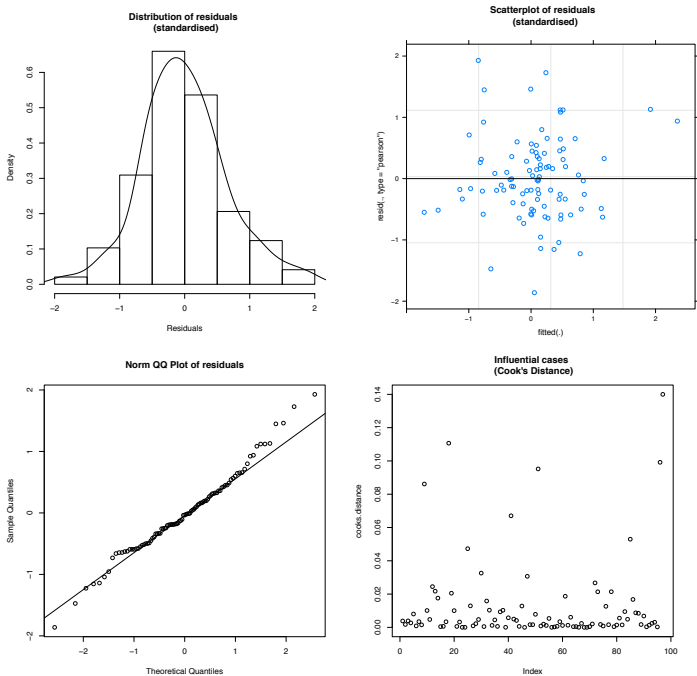


Figure E.4: Prediction 1.a Model Assumptions (Pre- to Post-Tournament): Team Performance Components Change Team Click Change

E.4.2 Prediction 1.b: Team Click predicts Social Bonding

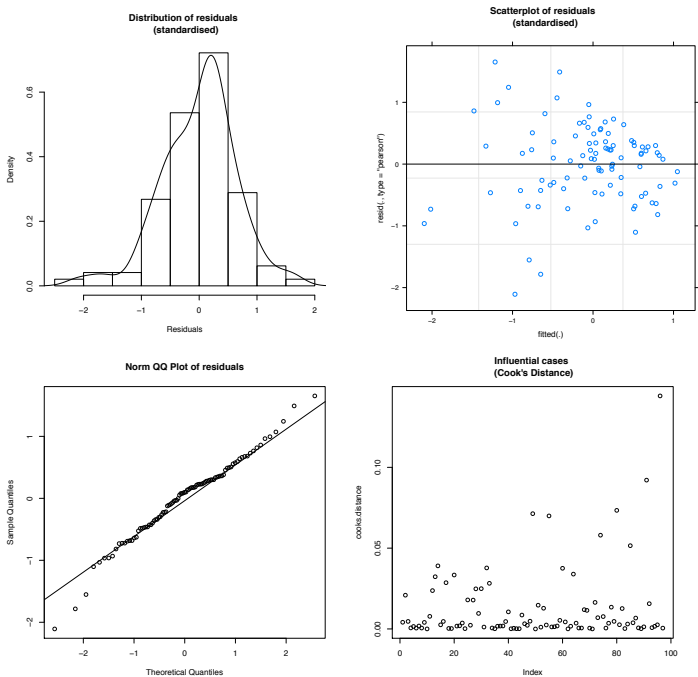


Figure E.5: Prediction 1.b Model Assumptions (Post-Tournament): Team Click predicts Social Bonding

Table E.8: Prediction 1.b (Post-Tournament): Team Click predicts Social Bonding (n = 97)

	Intercept	Main effect	Controls
(constant)	−0.01 (0.10)	−0.00 (0.07)	0.03 (0.39)
Team Click		0.64*** (0.08)	0.64*** (0.09)
Objective Competence			0.04 (0.08)
Subjective Competence			0.12 (0.07)
Final Rank			0.00 (0.04)
Minutes Total			−0.01 (0.00)
Points Total			−0.00 (0.01)
Fatigue			0.12 (0.09)
Extraverted			0.05 (0.05)
AIC	309.90	249.53	219.38
BIC	318.21	266.15	252.85
Log Likelihood	−151.95	−118.76	−96.69
Num. obs.	118	118	97
Num. groups: team	15	15	14

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .49$, Conditional $R^2 = .51$

Table E.9: Prediction 1.b (Pre- to Post-Tournament): Team Click Change predicts Social Bonding Change (n = 90)

	Intercept	Main effect	Controls
(constant)	0.34 ^{***} (0.09)	0.31 ^{***} (0.08)	0.29 (0.46)
Team Click Change		0.39 ^{***} (0.11)	0.37 ^{**} (0.14)
Objective Competence			0.08 (0.10)
Subjective Competence			0.01 (0.09)
Final Rank			0.00 (0.05)
Minutes Total			0.01 (0.00)
Points Total			0.00 (0.01)
Fatigue			−0.09 (0.10)
Extraverted			−0.03 (0.06)
AIC	265.55	256.54	241.81
BIC	273.34	272.11	274.31
Log Likelihood	−129.78	−122.27	−107.90
Num. obs.	99	99	90
Num. groups: team	14	14	13

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .17$, Conditional $R^2 = .23$

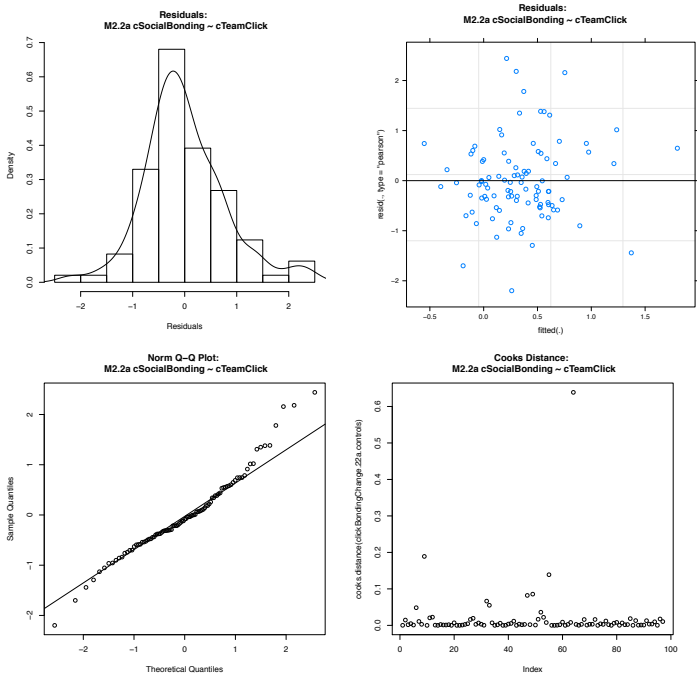


Figure E.6: Prediction 1.b Model Assumptions (Pre- to Post-Tournament): Team Click Change predicts change in Social Bonding Change

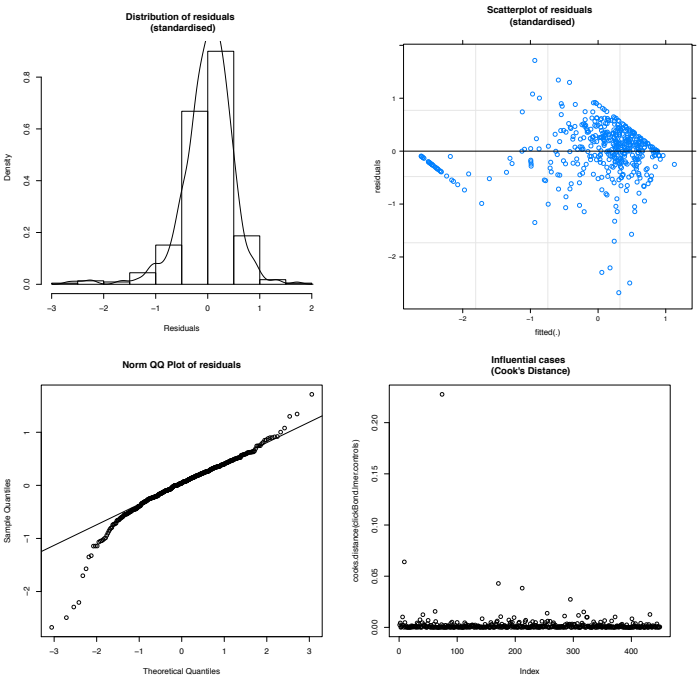


Figure E.7: Prediction 1.b Model Assumptions (Overall Tournament): Team Click predicts Social Bonding

E.4.3 Prediction 1.c: Team Performance Components predicts Social Bonding

Model comparisons

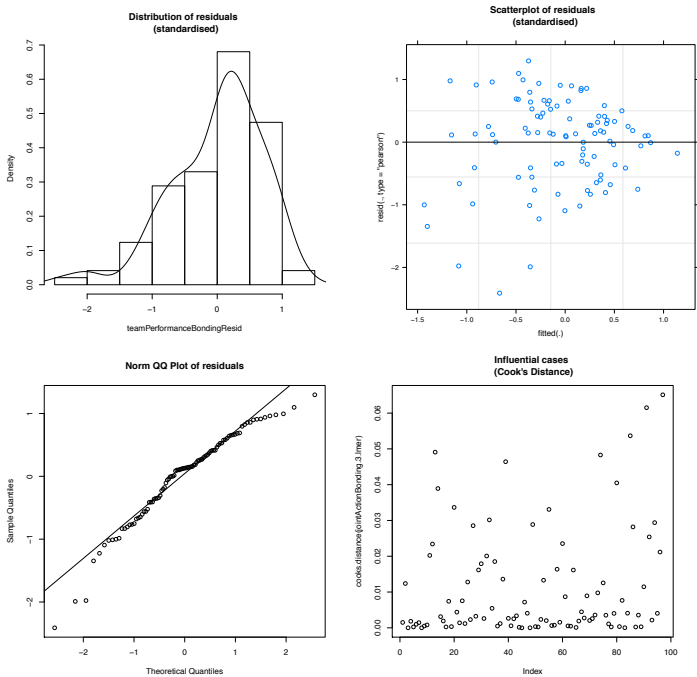


Figure E.8: Prediction 1.c Model Assumptions (Post-Tournament): Team Performance Components predict Social Bonding

Table E.10: Prediction 1.c (Post-Tournament): Team Performance Components predict Social Bonding (n = 97).

	Controls	Outliers removed	Log-adjusted
(constant)	−0.30 (0.44)	−0.09 (0.35)	1.88*** (0.19)
Team Performance Components	0.41** (0.14)	0.24* (0.10)	0.19** (0.06)
Ind Performance Components	0.03 (0.11)	−0.02 (0.09)	−0.01 (0.05)
Objective Competence	0.07 (0.10)	0.04 (0.08)	0.04 (0.04)
Subjective Competence	0.19* (0.08)	0.14* (0.06)	0.09** (0.03)
Final Rank	0.00 (0.05)	0.02 (0.04)	0.00 (0.02)
Minutes Total	−0.00 (0.00)	−0.00 (0.00)	−0.00 (0.00)
Points Total	−0.00 (0.01)	−0.00 (0.01)	−0.00 (0.00)
Fatigue	0.19 (0.10)	0.11 (0.09)	0.08 (0.04)
Extraverted	0.07 (0.06)	0.03 (0.05)	0.03 (0.02)
AIC	249.66	186.52	82.79
BIC	285.71	221.67	118.84
Log Likelihood	−110.83	−79.26	−27.39
Num. obs.	97	91	97
Num. groups: team	14	14	14

Coefficients with $p < 0.05$ in **bold**. Effect sizes for log-transformed model: Marginal $R^2 = .27$, Conditional $R^2 = .43$

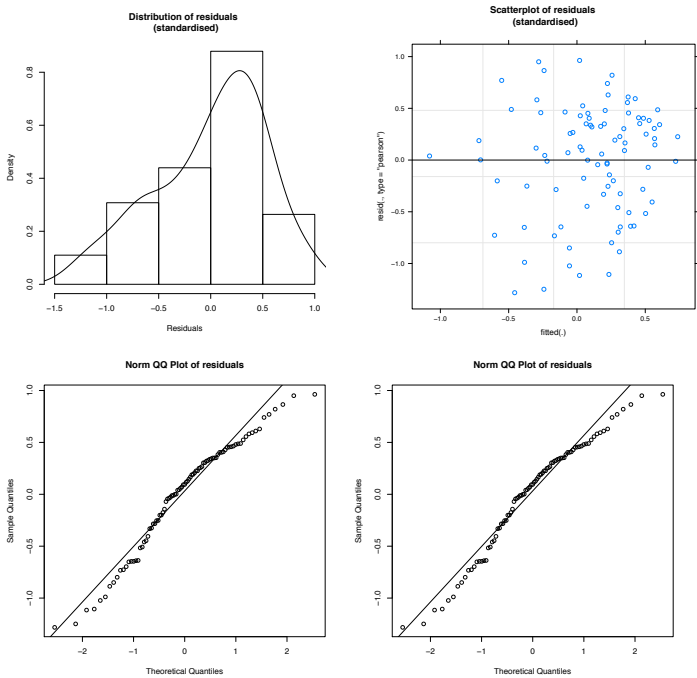


Figure E.9: Prediction 1.c Model Assumptions (Post-Tournament): Team Performance Components predicts Social Bonding (outliers removed)

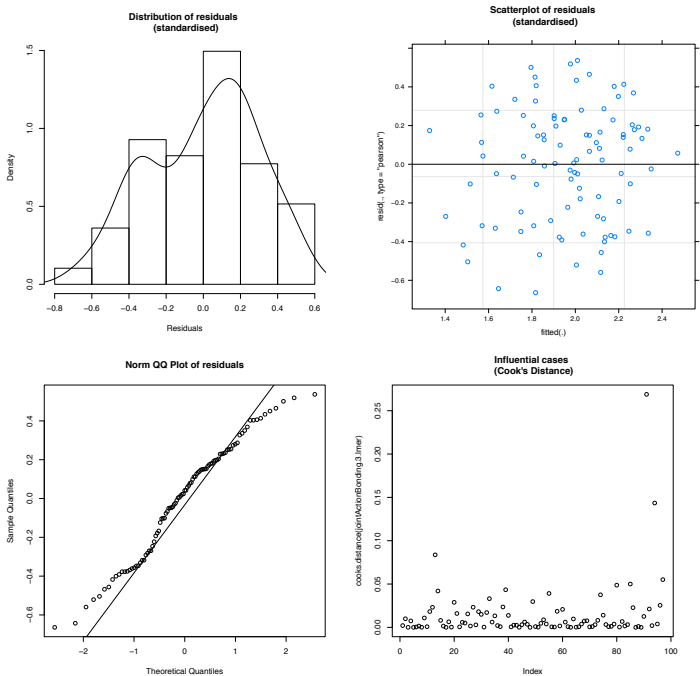


Figure E.10: Prediction 1.c Model Assumptions (Post-Tournament): Team Performance Components predicts Social Bonding (log-transformed)

Table E.11: Prediction 1.c (Pre- to Post-Tournament): Team Performance Components Change predict Social Bonding Change (n = 90)

	Controls	Outliers removed	Log-adjusted
(constant)	0.34*** (0.09)	0.35*** (0.09)	0.22 (0.46)
Team Performance Components Change		0.24*** (0.07)	0.36*** (0.09)
Ind Performance Components Change			-0.21 (0.11)
Objective Competence			0.17 (0.11)
Subjective Competence			0.03 (0.09)
Final Rank			-0.02 (0.05)
Minutes Total			0.01 (0.00)
Points Total			0.00 (0.01)
Fatigue			-0.18 (0.10)
Extraverted			-0.03 (0.06)
AIC	265.55	260.75	240.96
BIC	273.34	276.32	275.96
Log Likelihood	-129.78	-124.37	-106.48
Num. obs.	99	99	90
Num. groups: team	14	14	13

Coefficients with $p < 0.05$ in **bold**. Effect sizes for log-transformed model: Marginal $R^2 = .18$, Conditional $R^2 = .18$

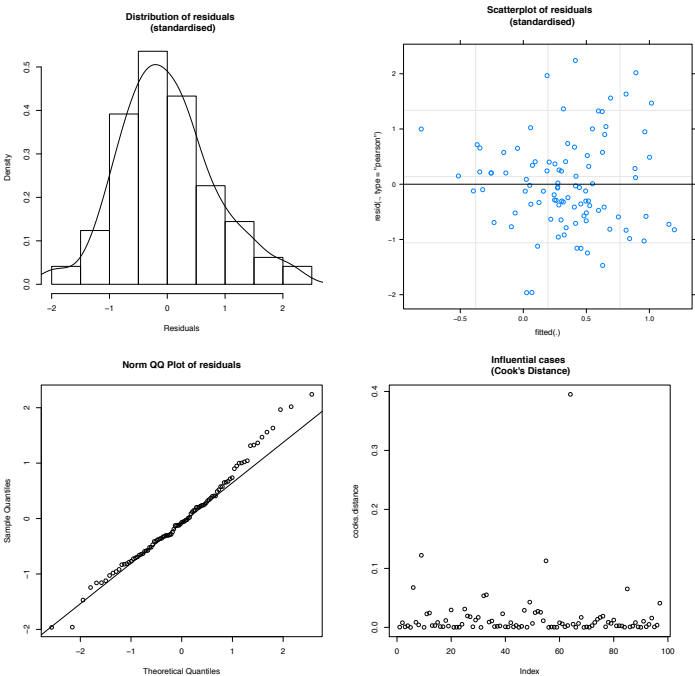


Figure E.11: Prediction 1.c Model assumptions (Pre- to Post-Tournament): Team Performance Components Change predicts Social Bonding Change

E.4.4 Prediction 2.a: Team Performance Expectations predicts Team Click

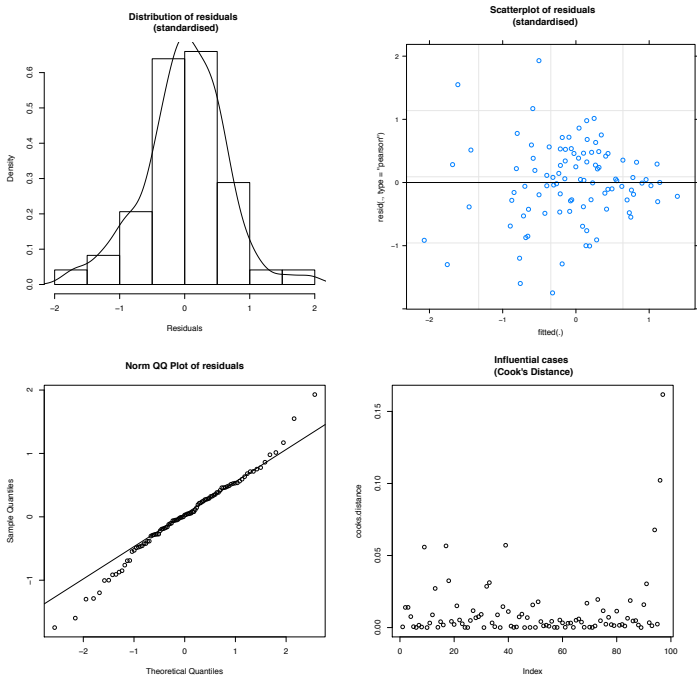


Figure E.12: Prediction 2.a Model Assumptions (Post-Tournament): Team Performance Vs Expectations predict Team Click.

Table E.12: Prediction 2.a (Post-Tournament): Team Performance Vs Expectations predicts Team Click (n = 97)

	Intercept	Main effect	Controls
(constant)	−0.04 (0.15)	−0.00 (0.09)	− 0.79* (0.40)
Team Performance Vs Expectations		0.50*** (0.11)	0.51*** (0.12)
Ind Performance Vs Expectations			0.02 (0.08)
Objective Competence			0.02 (0.08)
Subjective Competence			0.12 (0.07)
Final Rank			0.09* (0.05)
Minutes Total			−0.00 (0.00)
Points Total			0.00 (0.01)
Fatigue			0.18* (0.09)
Extraverted			0.06 (0.05)
AIC	299.06	268.43	228.63
BIC	307.37	285.06	264.68
Log Likelihood	−146.53	−128.22	−100.32
Num. obs.	118	118	97
Num. groups: team	15	15	14

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .40$, Conditional $R^2 = .56$

Table E.13: Prediction 2.a (Post-Tournament): Team Performance Vs Expectations predicts Social Bonding Change (n = 90).

	Controls	Log-adjusted	Outliers removed
(constant)	0.33 (0.51)	1.27*** (0.16)	0.40 (0.39)
Team Performance Vs Expectations	0.30** (0.11)	0.09* (0.04)	0.32*** (0.08)
Ind Performance Vs Expectations	−0.10 (0.10)	−0.03 (0.03)	− 0.22** (0.08)
Objective Competence	−0.15 (0.12)	−0.05 (0.04)	0.03 (0.10)
Subjective Competence	−0.15 (0.09)	−0.05 (0.03)	−0.03 (0.08)
Final Rank	−0.01 (0.06)	−0.00 (0.02)	−0.08 (0.04)
Minutes Total	0.00 (0.01)	0.00 (0.00)	−0.00 (0.00)
Points Total	0.00 (0.01)	0.00 (0.00)	0.01 (0.01)
Fatigue	−0.08 (0.11)	−0.00 (0.04)	−0.07 (0.09)
Extraverted	−0.06 (0.07)	−0.02 (0.02)	0.01 (0.05)
AIC	253.92	50.47	200.30
BIC	288.92	85.47	234.66
Log Likelihood	−112.96	−11.23	−86.15
Num. obs.	90	90	86
Num. groups: team	13	13	13

Coefficients with $p < 0.05$ in **bold**. Effect size of model excluding outliers: Marginal $R^2 = .17$, Conditional $R^2 = .20$

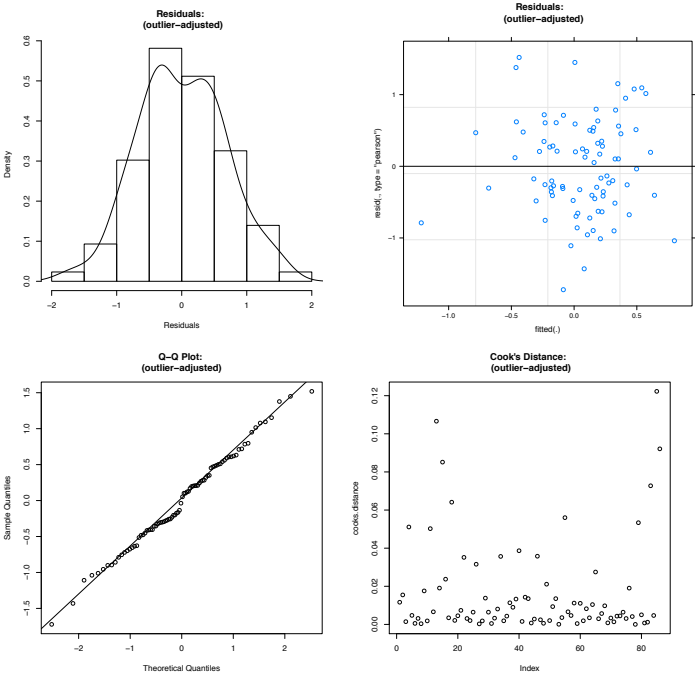


Figure E.13: Prediction 2.a Model Assumptions (Pre- to Post-Tournament): Team Performance Expectations predicts Team Click Change (outliers removed).

Table E.14: Prediction 2.a (Overall Tournament): Team Performance Vs Expectations predicts Team Click (n = 306).

	Intercept	Main effect	Controls
(constant)	−0.00 (0.04)	−0.06 (0.03)	−0.12 (0.21)
Team Performance Vs Expectations		0.74*** (0.03)	0.72*** (0.05)
Ind Performance Vs Expectations			0.12** (0.04)
Objective Competence			0.04 (0.04)
Subjective Competence			0.07 (0.04)
Final Rank			−0.00 (0.02)
Minutes Total			−0.00 (0.00)
Points Total			0.00 (0.00)
Fatigue			0.00 (0.00)
Extraverted			0.01 (0.03)
AIC	1552.70	842.67	602.59
BIC	1570.04	879.53	665.89
Log Likelihood	−772.35	−412.33	−284.30
Num. obs.	564	444	306

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .63$, Conditional $R^2 = .69$

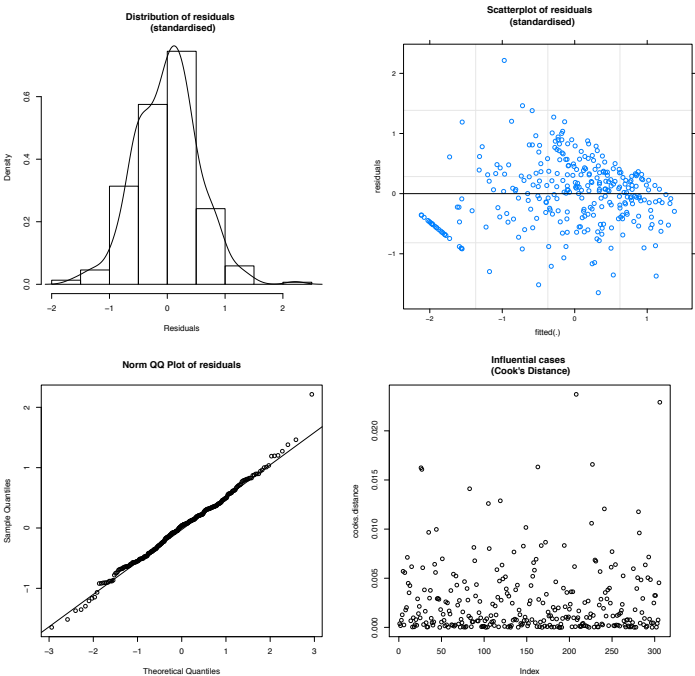


Figure E.14: Prediction 2.a Model Assumptions (Overall Tournament): Team Performance Vs Expectations predicts Team Click (n = 306)

E.4.5 Prediction 2.b: More positive perceptions of Team Performance Components will predict higher levels of Social Bonding

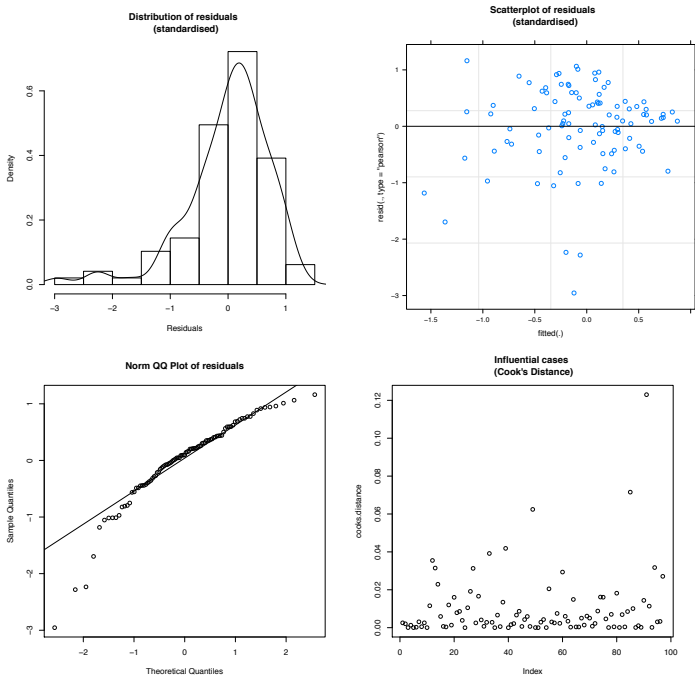


Figure E.15: Prediction 2.b Model Assumptions (Post-Tournament): Team Performance Components predicts Social Bonding

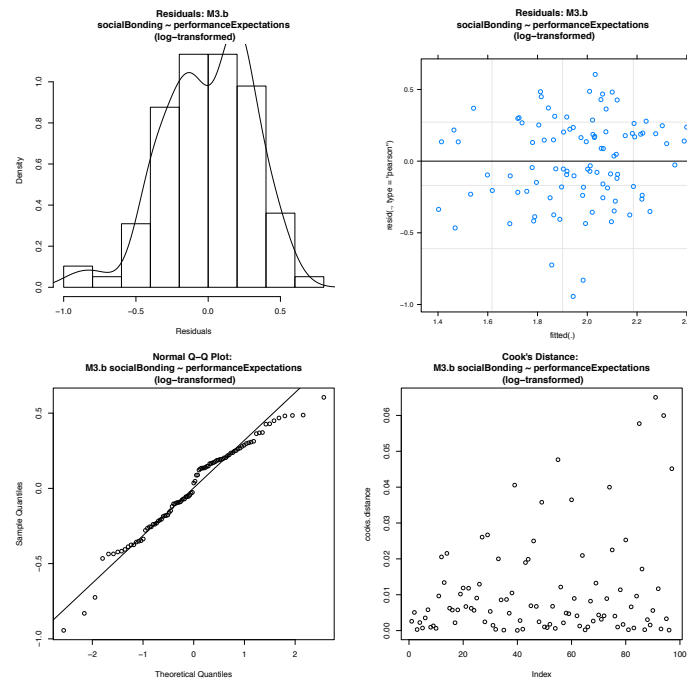


Figure E.16: Prediction 2.b Model Assumptions (Post-Tournament): Team Performance Components predicts Social Bonding (Log-transformed)

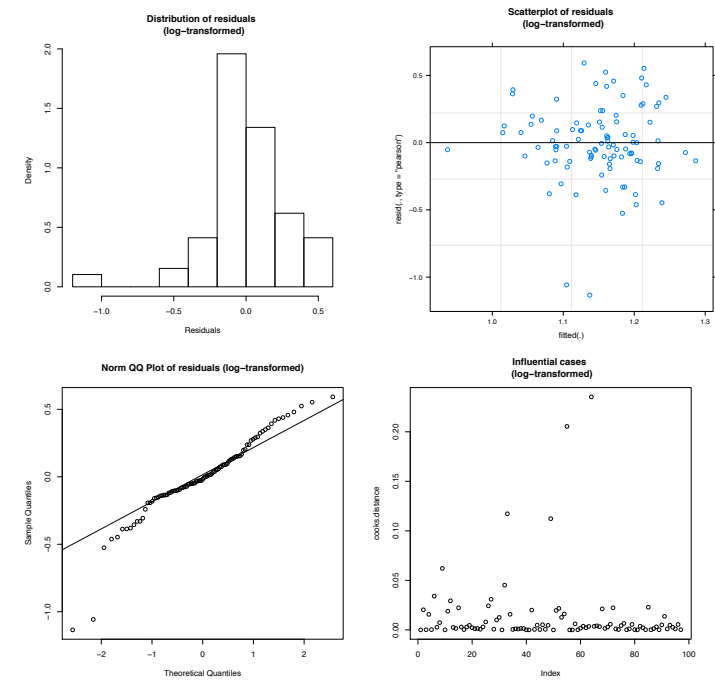


Figure E.17: Prediction 2.b Model Assumptions (Post-Tournament): Team Performance Vs Expectations predicts Social Bonding (Log-transformed model assumptions; assumptions violated).

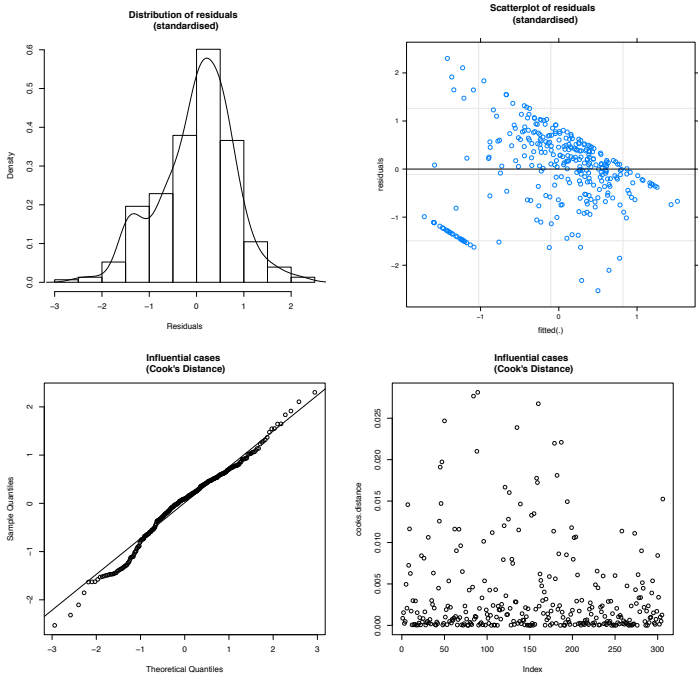


Figure E.18: Prediction 2.b Model Assumptions (Overall Tournament): Team Performance Vs Expectations predicts Social Bonding (Log-transformed).

F

Appendix: Training experiment

F.1 Method

F.1.1 Experiment condition primes

F.1.1.1 High difficulty condition prime

The drill you will be participating in today is a “4 on 2 + 2” drill taken from World Rugby. This drill, also known as “Invasion Drill” involves four attackers and two phases of two defenders in a 15m x 22m channel. The other group will be participating in a different type of drill. International coaches have assessed this drill based on a number of different factors (including drill complexity, coordination, intensity, skill requirement, etc.), and a sample of professional rugby players from all over the world, including China, have rated this drill based on its difficulty. World Rugby has combined these two measures and concluded that it is a very difficult drill for players to perform together successfully. This drill was given a score of 77.5/100, which translates to a difficulty rating of about 8/10. So the requirements of this drill—in coordinating both attack and defence—are quite high.

F.1.1.2 Low difficulty condition

The drill you will be participating in today is a “4 on 2 + 2” drill taken from World Rugby. This drill, also known as “Invasion Drill” involves four attackers

and two phases of two defenders in a 15m x 22m channel. The other group will be participating in a different type of drill. International coaches have assessed this drill based on a number of different factors (including drill complexity, coordination, intensity, skill requirement, etc.), and a sample of professional rugby players from all over the world, including China, have rated this drill based on its difficulty. World Rugby has combined both of these measures and concluded that it is a very easy drill for players to perform together successfully. This drill was given a score of 22.5/100, which translates to a difficulty rating of about 2/10. So the requirements of this drill—in coordinating both attack and defence—are quite low.

F.1.2 Invasion Drill pilot to derive approximate actual difficulty rating for the Invasion Drill

20 junior athletes from the Beijing provincial team ($male = 10$, $M(age) = 18$ ($SD = 2.1$)) were recruited to participate in a pilot study designed to test the difficulty rating of the Invasion Drill. Two separate pilot sessions were conducted, one with the men and another with the women. Following a routine warm-up procedure not involving a rugby ball (~ 10 minutes), athletes in each session completed 28 rounds of the Invasion Drill. Given that the drill required only 8 athletes, all 10 athletes rotated through two extra “resting” positions on the sideline of the drill. The Invasion Drill was also preceded by a more simple “2 on 1 + 1” attacking drill and then succeeded by a more complex “6 on 4 continuous” attacking drill. Athletes who were not required to participate in the 2 on 1 + 1 drill rested on the sideline of the drill and rotated with athletes after each trial. All ten athletes were engaged in the 6 on 4 continuous drill, and positions within these drills were rotated so that athletes performed each position in each drill. At the end of the training session, athletes were asked to privately record the perceived difficulty of each training drill from the pilot session using a ten-point scale (0 - “Extremely easy”, 5 - “Average”, 10 - “Extremely difficult”). These results were collected and collated by the researcher.

On average, athletes rated the Invasion Drill at 4.7/10 (range = 3 to 7). The more simple “2 on 1+1” attacking drill received an average rating of 2 (range =

1-4), and the more complex “6 on 4 continuous” attacking drill received an average rating of 6.2 (range = 4-10). Ratings of perceived difficulty did not noticeably vary by pilot group. This pilot study confirmed that it was appropriate to estimate the actual difficulty rating of the invasion drill at approximately 5/10. The high difficulty manipulation (8/10) and the low difficulty rating (2/10) could fall evenly at either side of this difficulty.

F.1.3 Drill explanation (constant across both conditions)

The drill will work as follows: when I blow the whistle, the first group of four attackers will assemble on the diamond pattern of four cones and prepare to attack, while two lines of two defenders each will assemble on the assigned cones, 10m apart from each other. When I blow the whistle a second time, the ball carrier at the top of the attacking diamond will tap the ball on his/her foot and proceed to engage the attack in a 4on2 scenario. The goal of the attacking group is to penetrate both lines of defence without being held by the defenders. After participating in the first line of defence, the first two defenders must stay put, and cannot follow the play and participate in the second line of defence.

Defenders can “hold/hug” attackers in order to hold the attack, but the drill is not a full-contact drill. Attackers can offload the ball at the first opportunity after making contact with a defender, if they are not fully held by the defenders. If the attacker does not unload the ball immediately, then the play is dead and the drill will be reset.

After every phase I will ask athletes to rotate clockwise around the drill, such that the ball carrier at the top of the diamond goes on to become a defender on the top right side of the square of defenders. Each individual athlete should attack a total of 8 rounds, and defend a total of 8 rounds, performing every position in the drill twice.

The drill will be recorded using a digital video camera, and individual athletes will be assessed based on their performance in attack and defence, using special video analysis software. I am particularly interested in how well players are able to coordinate with others in attack and defence.

F.1.4 Survey items

F.1.4.1 Baseline

Perceptions of performance

Survey items relating to performance included questions regarding athlete perceptions of their 1) overall team performance, 2) specific components of team performance, 3) overall individual performance, and 4) specific components of individual performance. These items were identical to those asked in the Pre-Tournament survey in Chapter 6.

Team Click

Athletes were asked about their feelings concerning team click among the entire provincial squad over the past month. Items included here were equivalent to survey items administered in the Tournament Survey.

Social Bonding

Athletes were asked about their perceptions of social bonding to their team over the past month, including perceived emotional support and shared goal, identity fusion (pictorial scale and 7 item verbal scale), and group identification (six-item scale). In addition, athletes were also asked about identity fusion to country and family, measured using the pictorial fusion scale, and were then asked to rank their level of fusion to team, country, and family in order of most fused to least fused.

Technical Competence

Athletes were asked about their individual technical competence, which included both objective and subjective measures (these measures were equivalent to items administered in the Tournament Survey)

Ten Item Personality Index

Athletes were asked to indicate on a 7-point Likert scale the extent to which they agreed with 10 pairs of adjectives as appropriate descriptions of their personality

Additional items

Athletes answered items relating to team discipline, injury status, and basic identification variables (for full description, see Appendix E.1.2.1).

F.1.4.2 Post-Drill surveys items

The final survey, administered immediately following the experiment, consisted of items designed to assess athlete perceptions of individual and group performance in the experiment relative to prior expectations, as well as perceptions of team click and social bonding to the training group. Athletes were asked if they would prefer to stay with their existing group or change to a new group for subsequent training experiments.

In addition to these group-specific items, the Post-Drill survey also included items regarding social bonding to the team as a whole (beyond an athlete’s specific training group), in order to assess any change in these measures due to their experience of joint action in the experiment. Finally, the Post-Drill survey also asked about current injury status and state of arousal and fatigue.

F.2 Results

F.2.1 Data Reduction

F.2.1.1 Team Discipline

Items concerning team discipline (attendance at meals, team curfew, general team conduct, punctuality to team engagements), measured at baseline and after the experiment, were subjected to EFA. Correlations between items were all reasonably high (all $r's > .63$), which suggested that one factor would be appropriate. The KMO index and Bartlett’s test both suggested high sampling adequacy, ($KMO = .78, \chi^2(6, 116) = 362.75, p < .0001$). One factor, labelled “Team Discipline” was imposed on the data, which explained 73.9% of the overall variance ($SSLoading = 2.96, Guttman's \lambda = .96 and Cronbach's \alpha = .92$ indicated that the data reduction was appropriate and reliable.

F.3 Analysis of Study Predictions

F.3.1 Prediction 2: More positive perceptions of team performance relative to prior expectations will predict higher levels of team click

Table F.1: Prediction 2 (Post-Drill): Team Performance Vs Expectations predicts Team Click (n = 53).

	Intercept	Main effect	Controls
(constant)	−0.02 (0.16)	−0.03 (0.15)	0.13 (0.91)
Group Performance Vs Expectations		0.56*** (0.09)	0.57*** (0.17)
Ind Performance Vs Expectations			0.01 (0.10)
Arousal			0.14 (0.10)
Trial Outcome Avg.			−0.03 (0.18)
Subjective Competence			0.10 (0.11)
Objective Competence			0.11 (0.10)
Extraverted			−0.01 (0.07)
AIC	156.33	131.18	133.01
BIC	162.46	139.35	156.65
Log Likelihood	−75.16	−61.59	−54.50
Num. obs.	57	57	53

Coefficients with $p < 0.05$ in **bold**.

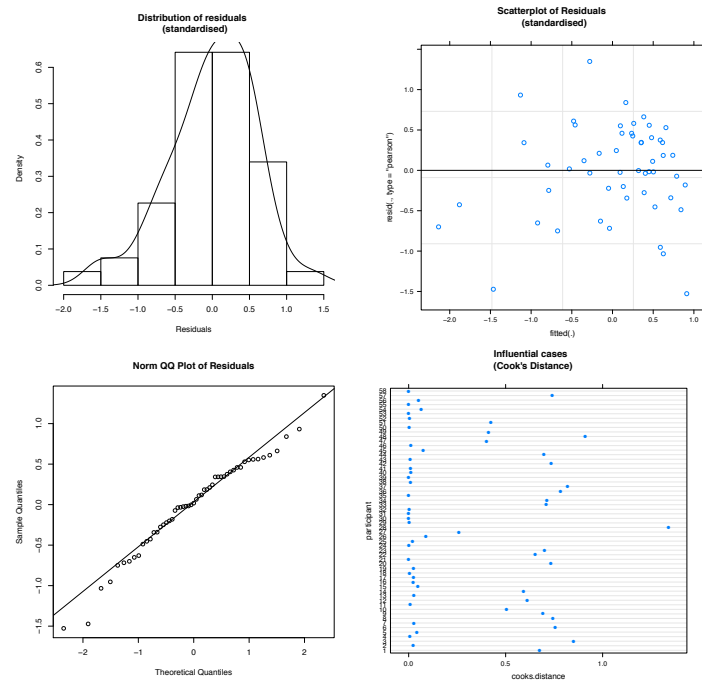


Figure F.1: Prediction 2 Model Assumptions (Post-Drill): Team Performance Vs Expectations predicts Team Click

Table F.2: Prediction 2 (Pre- to Post-Drill): Team Performance Vs Expectations Change predicts Team Click Change (n = 53).

	Intercept	Main effect	Controls
(constant)	-0.00 (0.13)	-0.00 (0.11)	-1.22 (1.04)
Group Performance Vs Expectations Change		0.57*** (0.11)	0.54*** (0.12)
Ind Performance Vs Expectations Change			0.21 (0.12)
Arousal			-0.05 (0.13)
Trial Outcome Avg.			0.26 (0.19)
Subjective Competence			0.13 (0.12)
Objective Competence			0.01 (0.13)
Extraverted			0.04 (0.08)
AIC	166.75	146.59	147.49
BIC	172.88	154.77	171.14
Log Likelihood	-80.38	-69.30	-61.75
Num. obs.	57	57	53

Coefficients with $p < 0.05$ in **bold**.

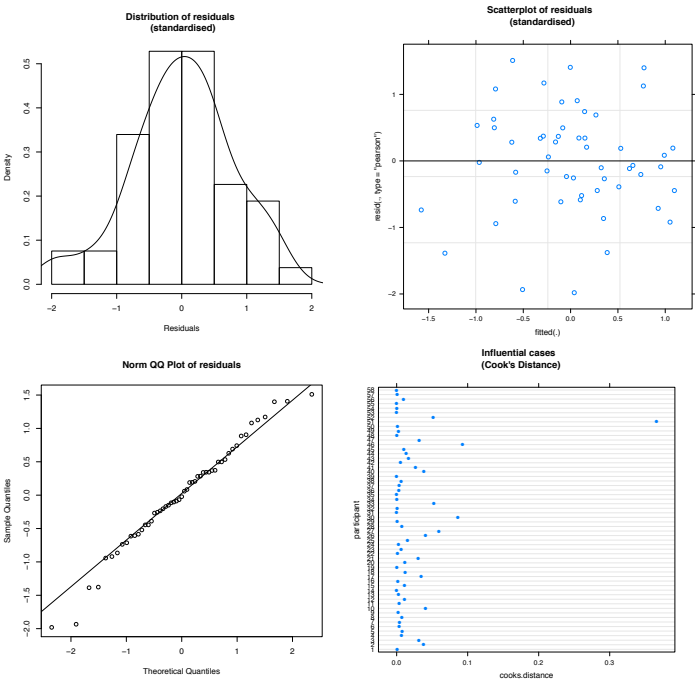


Figure F.2: Prediction 2 Model Assumptions (Pre- to Post-Drill): Team Performance Vs Expectations predicts Team Click Change

F.3.2 Prediction 3: Higher levels of team click will predict higher levels of social bonding (to the training group and the provincial team)

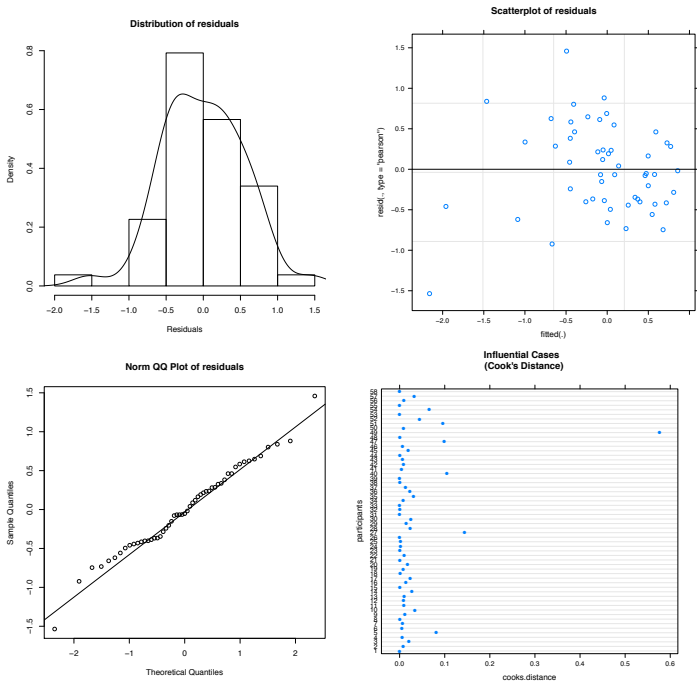


Figure F.3: Prediction 3.a Model assumptions (Post-Drill): Team Click predicts Social Bonding

Table F.3: Prediction 3.a (Post-Drill): Team Click predicts Social Bonding (n = 53).

	Intercept	Main effect	Controls
(constant)	−0.15 (0.16)	−0.12 (0.08)	0.22 (0.72)
Team Click		0.67*** (0.08)	0.63*** (0.09)
Arousal			0.14 (0.09)
Trial Outcome Avg.			0.02 (0.13)
Subjective Competence			0.02 (0.09)
Objective Competence			−0.03 (0.09)
Extraverted			−0.09 (0.06)
AIC	145.09	106.93	106.51
BIC	151.22	115.10	128.18
Log Likelihood	−69.55	−49.47	−42.25
Num. obs.	57	57	53

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .59$, Conditional $R^2 = .59$

Table F.4: Prediction 3.a (Post-Drill): Team Click Change predicts Social Bonding Change (n = 53).

	Intercept	Main effect	Controls
(constant)	−0.02 (0.17)	−0.03 (0.17)	1.55 (1.12)
Team Click Change		0.43** (0.13)	0.27* (0.15)
Ind Performance Change			0.18 (0.13)
Trial Outcome Avg.			−0.26 (0.21)
Subjective Competence			−0.01 (0.13)
Objective Competence			0.04 (0.13)
Extraverted			−0.08 (0.08)
AIC	165.82	158.94	152.72
BIC	171.95	171.19	174.40
Log Likelihood	−79.91	−73.47	−65.36
Num. obs.	57	57	53

Coefficients with $p < 0.05$ in **bold**. Marginal $R^2 = .23$, Conditional $R^2 = .24$

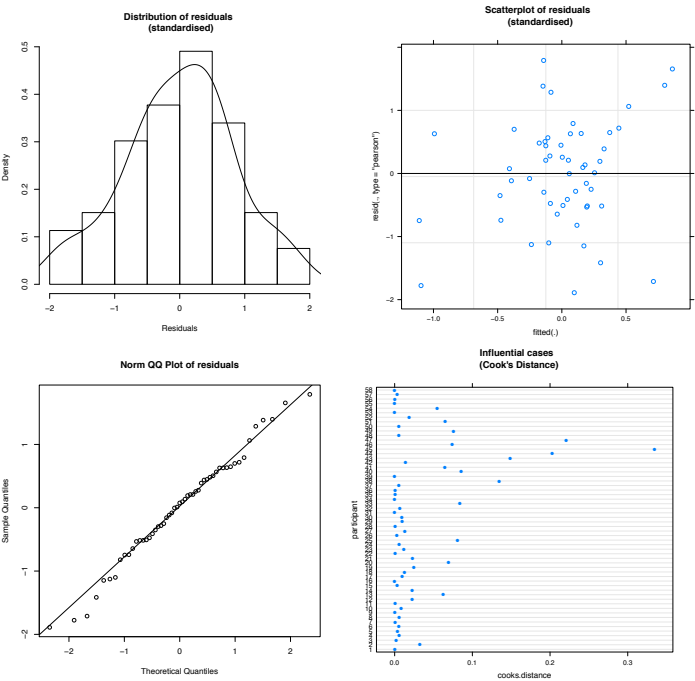


Figure F.4: Prediction 3.a Model assumptions (Pre- to Post-Drill): Team Click Change predicts Social Bonding Change team (n = 53).

Table F.5: Prediction 3.b (Post-Drill): Team Click predicts Social Bonding (Province) (n = 53).

	Intercept	Main effect	Controls
(constant)	−0.05 (0.16)	0.35 (0.69)	0.35 (0.69)
Team Click		0.50*** (0.15)	0.50*** (0.15)
Arousal		0.06 (0.08)	0.06 (0.08)
Trial Outcome Avg.		0.04 (0.13)	0.04 (0.13)
Subjective Competence		−0.16 (0.09)	−0.16 (0.09)
Objective Competence		0.11 (0.08)	0.11 (0.08)
Extraverted		−0.09 (0.05)	−0.09 (0.05)
AIC	142.61	104.93	104.93
BIC	148.74	126.60	126.60
Log Likelihood	−68.30	−41.46	−41.46
Num. obs.	57	53	53
Num. groups: sessionName	8	8	8
Var: sessionName (Intercept)	0.12	0.03	0.03
Var: Residual	0.56	0.23	0.23
Var: sessionName groupClickPostFactor		0.10	0.10
Cov: sessionName (Intercept) groupClickPostFactor		−0.05	−0.05

Coefficients with $p < 0.05$ in **bold**.

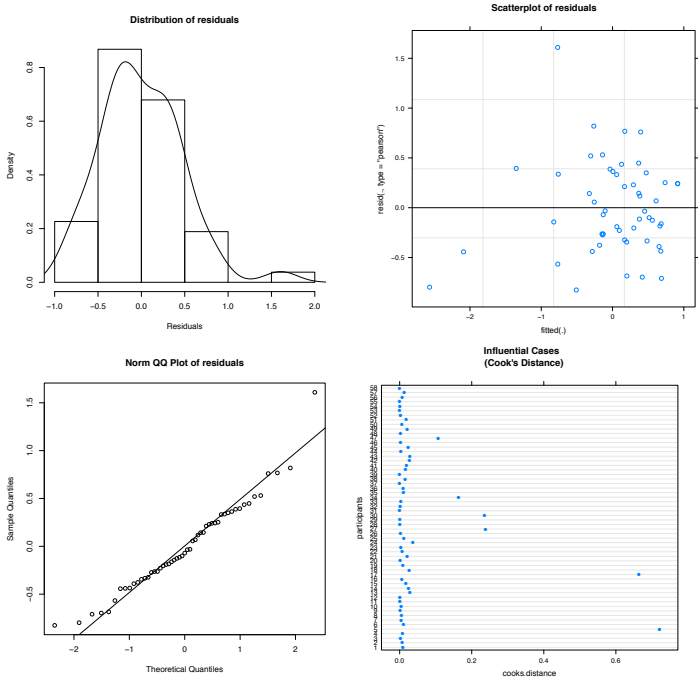


Figure F.5: Prediction 3.b Model assumptions (Post-Drill): Team Click predicts Social Bonding to the Provincial Team (n = 53)

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