Effects of synchronous chanting and identity fusion on perceived ingroup formidability, outgroup threat, and parochial altruism among soccer fans

ABSTRACT (250 words)

Previous research indicates that social synchrony simultaneously increases ingroup bonding and prosociality, whilst also having the potential to make groups appear more formidable or threatening. However, many such studies have been carried out in artificial settings or in minimal groups which lack preexisting bonds or histories of prosocial action or intergroup rivalry. Here we investigate: 1) whether a synchronous display is perceived as more formidable by ingroups and outgroups, and more threatening by outgroups, in a real-world context involving football (soccer) fans; 2) whether these perceptions extend to behavioral decisions towards ingroups and outgroups; and 3) whether 'identity fusion' with the ingroup moderates these relationships. A sample of 771 Brazilian soccer fans took part in a pre-registered conceptual replication online study in which they randomly listened to either a synchronous or asynchronous soccer chant. Both ingroups and outgroups judged the synchronous stimuli to make the performers seem more formidable, but not more threatening. At the behavioral level, we found no effect for synchrony on pro-group behaviors or outgroup derogation, but there was a significant interaction indicating that highly 'fused' participants who perceived rival fans to be more threatening tended to engage in more outgroup hostility, even at a cost to self. These results parallel previous studies showing synchrony's effects on perceived ingroup formidability and provide novel insights into the role of social bonding and perceived outgroup threat as contributing factors in the evolution of intergroup conflict in real world situations.

Keywords: synchrony, identify fusion, threat, ingroup cooperation, intergroup hostility, IPD-MD game

Highlights – 3-5 bulletpoints

maximum 85 characters, including spaces, per bullet point

- Listening to synchronous chanting increased attributions of formidability
- Listening to synchronous ingroup chanting did not increase pro-group behavior.
- Identity fusion moderated threat effects for outgroup hostility
- ‘Fused’ participants who perceived more threat showed more outgroup hostility.

1. Introduction

Behavioral synchrony, thought to enhance social bonding and cohesion within groups, is a widely recurrent feature in religious, military, musical, theatrical, and sports-related activities (for field studies demonstrating these effects, see (Fischer et al., 2013; Jackson et al., 2018); for a meta-analysis of experimental studies, see (Mogan et al., 2017). Cultural group selection offers one possible explanation for the ubiquity of social synchrony because when groups compete for scarce resources (Hagen & Bryant, 2003), increasing ingroup cohesion and outgroup perceived threat and formidability via social synchrony would confer a competitive advantage, all else being equal (Hagen & Bryant, 2003).

Fessler and Holbrook (2016) investigated how outgroups perceived a synchronous display (i.e., an audio track with soldiers marching either synchronously or asynchronously) in terms of formidability and potential threat. Participants perceived two marching soldiers as more "formidable" (bigger, stronger, and more united) and more threatening than asynchronous marchers, suggesting that the physical formidability of a foe can enhance perceived fighting capacity, as well as increase perceived threat. These perceptions could affect the decision to fight, flee, appease, or negotiate with the antagonistic outgroup (Fessler & Holbrook, 2014; Hagen & Bryant, 2003). We aim to conceptually replicate and extend these findings by Fessler and Holbrook (2016).

First, a significant number of psychological experiments have not been replicated when using pre-registration (Nosek et al. 2022; Open Science Collaboration, 2015), making it essential to pre-register and conceptually replicate findings. A meta-analysis suggested that there was overall no effect of publication status, but an inspection of the forest plots suggests that unpublished studies had weaker and often non-significant effects (Mogan et al., 2013). Second, current studies focusing on evolutionary models have been primarily conducted in English-speaking or European countries (see the experiments with behavioral outcomes in Mogan et al.'s analysis and the natural experiments conducted with participants in English-speaking countries, e.g., Fischer et al., 2013; Jackson et al., 2018). In order for evolutionary arguments to be held, we need a larger evidence base across a greater diversity of human samples. Third and most importantly, we focus on a naturalistic context with real-world application and implications: soccer fans.

Previous studies have suggested that out-of-context laboratory studies may not adequately capture real-world intergroup behavior (Fischer & Derham, 2016; Weisel & Böhm, 2015), making it necessary to test dynamics with group affiliations that are relevant and meaningful to individuals. Conceptually, we argue that ingroup affiliation (not just group membership) is important when considering the effects of social synchrony in intergroup contexts. In Fessler and Holbrook's (2016) study, for example, although participants shared the same nationality with performers in the audio stimuli,

they were not necessarily part of the group used in the experimental manipulation that were behaviorally relevant (i.e., participants were not members of the US army or ISIS, nor necessarily rivals of these groups).

We expand the previous literature by investigating three key themes: a) whether synchronous displays increase perceived formidability and threat, as reported by Fessler & Holbrook (2016)., occurs in a natural context (i.e., among chanting Brazilian soccer fans); b) whether synchronous displays increase ingroup altruistic behavior as well as outgroup derogation; and c) whether extreme social bonding (i.e., identity fusion) moderates these effects. In addition, our pre-registered replication adds rigor to the existing literature that has often relied on studies without pre-registration that are open to selective reporting or p-hacking (Wicherts et al., 2016). Using a distinct cultural background, such as the Brazilian fan context, also helps to overcome some of the potential cultural biases in the existing synchrony literature and helps to increase our confidence in the mechanisms underlying inter-group behaviors. Here, we use the concept of identity fusion - a visceral feeling of oneness with groups that evolved in small, tight-knit groups (Swann et al., 2012; Whitehouse, 2018) - as a measure of intense group cohesion, which may influence how synchrony signals are processed and thereby moderate the effect of social synchrony on ingroup/outgroup behavior.

1.1. Synchronous displays and group dynamics

Synchronous displays are a prevalent phenomenon observed across various animal species, with manifestations seen, for example, in fireflies (Buck & Buck, 1968), frogs (Grafe, 1996), bees (Kastberger et al., 2008), and birds (Bajec & Heppner, 2009). These displays serve diverse purposes, ranging from mating rituals to the deterrence of potential predators (Merker et al., 2009; Ravignani et al., 2014). The evolutionary underpinnings of synchronous displays in nonhuman animals remain a subject of ongoing debate, and the rationale behind such behavior may vary among species.

Several evolutionary theories have surfaced to explain synchronous musical displays in humans, a body of research that underpins even the relatively mono-pitched chants that soccer is famous for. Each of these theories contributes to our understanding of synchronous musical displays underlying purpose and are not necessarily mutually exclusive. While some propose that these displays might represent byproducts of other adaptations (Liénard & Boyer, 2006), others assert that they serve as an adaptation aimed at nurturing social bonds (Savage et al., 2021), signaling mate quality (Van Den Broek & Todd, 2009), or indicating coalition quality (Hagen & Bryant, 2003). Developing the work by Fessler & Holbrook (2016), this manuscript will emphasize the coalition signaling quality hypothesis as the foundation for our experimental work.

Within the coalition signaling quality hypothesis framework, music emerges as a potent and credible signal, effectively conveying information to listeners who may avoid agonistic encounters with the signalers (Mehr et al., 2021). This hypothesis has

been extended to suggest that musical displays may also serve as a mechanism for deterring predators and fulfilling ingroup signaling functions (Hagen, 2022). Critically, this perspective specifies hypotheses on synchronous signaling at the group level (within and between) groups, in contrast to frameworks focusing on the effects of synchronicity at the individual level, such as the effects of joint musical performances (Savage et al., 2021), or sexual selection (Mosing et al., 2015). In this case, the same signal has different meanings depending on whether the receiver is an ingroup or outgroup member (e.g., it involves the same cognitive mechanisms but different reactions depending on context). This highlights the critical role of the receiver's cognitive and psychological processes in shaping the form and function of signals (Guilford and Dawkins, 1991). Within the context of soccer, chanting signals serve a dual purpose, influencing both the ingroup (motivating fans and players) and the outgroups (potentially intimidating rival fans and players).

For ingroup members, synchronous behavior may engender and signal shared intentionality and cooperative ability, providing positive feedback and reinforcing group cooperation. This reinforcement hypothesis has been supported in experimental studies (Reddish et al., 2013) and provides one plausible proximal mechanism of how synchrony enhances social bonding and cooperation among ingroups. From an evolutionary perspective, increased group cohesion could drive cultural evolutionary forces (Henrich & Muthukrishna, 2021; Whitehouse & Lanman, 2014), leading to the adoption of synchronous rituals across human societies. Relatedly, a further evolutionary hypothesis for the biological origins of highly synchronized music and dance group performances is that they evolved from territorial advertisements (Hagen & Bryant, 2003; Hagen & Hammerstein, 2009; Mehr et al., 2021), which has clear links to regionalized soccer chants.

Therefore, synchronous display of chants and instrument playing could also serve as out-group attack deterrence, portraying the ingroup as more coherent, formidable, and capable of fighting back in case of a clash (Hagen, 2022). Outgroup synchronous displays signal the ability to effectively coordinate group members, which implies greater strength and internal cohesion to non-group members (Fessler & Holbrook, 2014, 2016; Hagen & Bryant, 2003; McNeill, 1995). These outgroup synchronous displays could lead, at the proximate level, to an increased perception of formidability and threat (Fessler & Holbrook, 2014, 2016). Again, from an evolutionary standpoint, synchronous displays would be maintained in the population to increase ingroup cohesion and outgroup perceptions of formidability, thus maintaining access to resources and reproductive opportunities (Hagen, 2022).

In Fessler & Holbrook’s original paper (2016), which we in part aimed to replicate conceptually, formidability was operationalized as perceived group size and muscularity, which are not directly related to fighting capacity. This choice was reportedly made to avoid biased responses by participants’ affiliations (e.g., ingroups

could always evaluate their group as more capable of fighting). The authors' decision, which we follow in the present study, was based on a series of studies indicating that physical size and strength (muscularity) are relevant for fighting capacity and that the ability to estimate these traits is necessary in the context of agonistic decision-making (Fessler & Holbrook, 2016). The original studies made substantial progress in understanding the evolutionary basis for synchronous group displays. In the present study, we extend this body of research substantially by moving beyond online US studies that use artificial scenarios unrelated to real-world settings. Instead, we explore how these dynamics operate in a more naturalistic context, in which group boundaries have meaningful histories for participants. Fessler and Holbrook (2016) used a non-military US sample listening to (a)synchronous marching soldiers (either from the US or a terrorist organization) as the stimulus to be judged regarding formidability and other variables relevant to the coalition quality signaling hypothesis. Here, we use a similar experimental design but focus on a more naturalistic context in which group boundaries have meaningful histories for participants and with real-life potential agonistic interactions: Brazilian soccer fans.

1.2. Soccer fans as a model for intergroup research

Soccer generates billions of dollars a year, which translates to hundreds of hours of investment from committed fans and has been likened to a 'tribal' psychology akin to the coalitional psychology required for warfare, raiding, or hunting big game in our ancestral past (Elbert et al., 2010; Newson, 2017) In 2020 the European market alone was estimated to be worth EUR28.6bn (Deloitte Sports Business Group, 2020). Fans are highly invested in their respective teams and travel long distances, spending large amounts of money and time following their clubs. Given the salience of soccer for supporters, studying group psychology in this context should allow us to unpack threat and parochial altruism effects in a meaningful, real-world setting.

Importantly, soccer-based groups display various signals to broadcast their allegiance, both visually (e.g., shirts or even tattoos), as well as through synchronous chants and coordinated movements in the stadium. Anthems are an important, seemingly universal, feature of soccer culture. They are present both inside and outside of the stadium and their lyrics represent the history and personality of the team. Undoubtedly, during soccer matches, these anthems create an atmosphere capable of both enhancing the sense of belongingness among supporters and affecting players on the field, most evident in the home-team advantage (Nevill et al., 2002). What makes soccer particularly interesting for studying intergroup behavior in naturalistic settings is that soccer fans often engage in hostile and violent behavior towards rival outgroups. In our study context of Brazil, for instance, there has been an increase in deaths from soccer-related violence and the possibility of having agonistic encounters with rival fans leading to either physical or verbal violence is real (Murad, 2013; Raspaud & da Cunha Bastos, 2013). Moreover, soccer fans resemble other tight-knit – and potentially hostile

- groups in their psychological characteristics (Newson, 2017; Newson et al., 2018), providing potential generalizability for group dynamics in general. Therefore, soccer fans provide a relatively safe platform to investigate synchrony effects for extreme group bonding and associated altruistic and hostile intergroup behavior (Newson et al., 2022) with real-world, evolutionary consequences.

Brazil is famed for its passion for soccer: the only nation having won the soccer World Cup five times and the only nation to have qualified for every World Cup tournament. Classic discussions of Brazilian culture commented on the centrality of soccer for Brazilians (de Oliveira Torres, 1973). Within Brazil, one of the most famous clubs is *Flamengo*, a club from Rio de Janeiro. It has the largest nationwide fanbase and a long and celebrated history of rivalry with the other four major clubs in the city. *Flamengo's* matches with its rivals are broadcast on national TV and typically attract high viewer ratings. The team's success has varied over time, with fluctuations on the field and in the relative strength of *Flamengo's* various fan clubs. Hence, affiliation with Flamengo or its Rio-based rivals provides a real-world context to study the effects of social synchrony on group psychology and behavior.

Fessler and Holbrook (2016) considered the formidability measure indexed by group size perception and muscularity as a summary of potential threats by hostile individuals. Here, taking into account the more naturalistic aspect of our sample and the higher probability of facing agonistic interactions with rival fans (e.g., in matches or in the streets wearing a jersey), we also measured directly perceived threats (physical and verbal). According to the coalitional signaling hypotheses, the perceived threat could be modulated by synchronous displays, a currently under-explored pathway.

1.3. Behavioral ingroup love vs outgroup hate

Previous studies have shown the effects of synchronous behaviors on perceptions of physical formidability and threat perception during coalitional scenarios (from both ingroup and outgroup perspectives). Our work seeks to extend these results by examining whether such effects also modulate intergroup behavioral decisions. Although there are several indications that interpersonal behavioral synchrony increases ingroup cooperation (Fischer et al., 2013; Jackson et al., 2018; Mogan et al., 2017; Rennung & Göritz, 2016; Wiltermuth & Heath, 2009), it is not clear whether synchrony as a coalitional signal would have a similar effect. We aimed to expand the previous research by focusing on synchrony as a coalitional signal in the context of a relevant social group for the participants.

Group members tend to behave altruistically towards ingroups when motivated by a sense of belongingness, but do not necessarily show hostility towards outgroups (Brewer, 1999; Roccas et al., 2008). This suggests that ingroup love and outgroup hate are conceptually distinct. However, when it comes to relevant social groups that people have strong ties to (e.g., political parties, soccer clubs), the extent to which ingroup love and outgroup hate are truly independent of one another is more debatable (Abbink &

Harris, 2019; Weisel & Böhm, 2015). Moreover, individuals whose identity has become fused with the group tend to be prone to harm outgroups when under threat (Fredman et al., 2017; Newson et al., 2022), an effect mediated by perceived formidability (Vázquez et al., 2020).

To elucidate the motivations behind ingroup love and outgroup hate, Halevy and colleagues (Halevy et al., 2008) created the Intergroup Prisoner's Dilemma-Maximizing Effect (IPD-MD) paradigm, extending previous work by Bornstein (Bornstein, 1992). Participants need to decide between a purely selfish decision (keeping a pool of money for themselves), a costly decision to oneself that benefits the ingroup and does not affect the outgroup ("ingroup love", giving money to the ingroup, which will be discounted from the person's pool), or a costly decision that benefits the ingroup whilst simultaneously harming the outgroup ("outgroup hate", giving money to the ingroup while at the same time reducing the funds available to the outgroup). These decisions mimic real-world decisions that individuals may have to make, e.g., spending large amounts of time and money on supporting their own team (ingroup love); or supporting any other team on specific occasions (e.g., by donating both time and money) simply because the team happens to be playing against one's own team's rivals.

The motivation for this outgroup hate is to hurt the rival in question. This behavioral tactic (termed 'torcida contra', literally 'opposing fan') is common in Brazil, which makes the IPD-MD behavioral matrices relevant for this important behavioral feature of Brazilian soccer. This paradigm has been used in real world contexts with meaningful groups (i.e., political parties, soccer clubs) and in these contexts increased outgroup hate has been reported compared to minimal group contexts (Weisel & Böhm, 2015). This experimental paradigm has been further supported in Brazilian, Spanish, and British soccer fans by Buhrmester and colleagues (2018). In summary, it is important to study the relevance of previous ties and significance of the group for behavioral decisions; important contexts which are absent in minimal group contexts.

1.4. Identity fusion & threat dynamics

Identity fusion is defined as a visceral feeling of oneness with a group (Swann et al., 2012; Whitehouse et al., 2017) and has been shown to capture salient motivations of ingroup affiliation (Whitehouse et al., 2017) and intergroup behavior in real-world contexts (Swann et al., 2009; Swann, Gómez, Huici, et al., 2010). The theory of identity fusion (Swann et al., 2009, 2012; Swann & Buhrmester, 2015) proposes that some individuals develop intense feelings of belonging to a group, in which one's personal identity becomes fused to one's social identity. This leads to a deep bond with not only the ingroup category, but also relational ties with its individual members (Buhrmester & Swann, 2015). This process creates 'family bonds' or 'psychological kinship' with members of the ingroup, even in the absence of biological kinship (Buhrmester et al., 2015; Gómez et al., 2011), increasing the perception of common values and strongly binding members of a group (Gómez et al., 2011; Vázquez et al., 2020). Thus, fused

group members develop a sense of reciprocal strength that imbues a feeling of invulnerability (Gómez et al., 2011) and caring for the welfare of the ingroup. Functional MRI evidence on identity fusion dynamics converge with studies on kinship and altruistic decisions towards societal causes, all pointing to the medial prefrontal cortex and closely associated cortical and subcortical structures (Apps et al., 2018; Moll et al., 2006; Rüsch et al., 2014). These results indicate that studying identity fusion can add mechanistic understanding to group behavior. Substantial research indicates that soccer evinces an extreme and enduring social bond, i.e., identity fusion (Newson, 2019). This visceral sense of 'oneness' between fans has been demonstrated among Brazilian fans (Bortolini et al., 2018; Newson et al., 2018), British fans (Newson et al., 2016, 2023), Australian fans (Knijnik & Newson, 2021), and Polish fans (Kossakowski & Besta, 2018). Consequently, identity fusion emerges as a strong candidate as a proximate variable influencing behavioral outcomes following exposure to the synchronous displays under examination in this study. Particularly noteworthy is its role in shaping the amplified perception of threat, a central tenet of the coalitional signal hypothesis (Fredman et al., 2017).

Past research has suggested that threats to one's group are interpreted by highly fused individuals as personal threats, which in turn may lead to more extreme behaviors to defend one's group/oneself (Buhrmester et al., 2015; Fredman et al., 2017; Swann et al., 2014; Swann, Gómez, Dovidio, et al., 2010; Whitehouse, 2018; Whitehouse et al., 2014). When self and group are fused, threat activates an intensified feeling of personal agency, which also amplifies the will to both sacrifice oneself for the group and stimulate more extreme behaviors to protect fellow members (Swann, Gómez, Huici, et al., 2010). Within the context of soccer, fusion to one's club when combined with a sense of threat from rival teams or fan clubs may explain soccer-based violence (Newson, 2017; Newson et al., 2018, 2022). On the other hand, fusion is nuanced and context-dependent, also associated with 'barrier-crossing altruism', whereby fused individuals can behave altruistically to their rivals (Newson et al., 2022). This indicates that different predictors might be involved in situations when fusion leads to outgroup hate or altruism. Summarizing, identity fusion in the presence of perceived threat is likely to increase both ingroup altruistic behaviors and more hostile outgroup behavior, unless there are specific cues that the group would not benefit from hostility. The dynamics observed in previous studies provide an opportune context to examine how synchrony effects play out and whether perceived synchrony effects are amplified among individuals with greater identity fusion and who perceive higher levels of threat.

1.5. The present study

Linking these lines of work together, we conceptually replicate and expand the original studies by Fessler and Holbrook (2016) by testing novel aspects of the coalition signal hypothesis and investigating potential proximate causes (i.e., identity fusion) that could potentiate the effects of synchronous displays, and its effects on behavioral outcomes (i.e., ingroup love and outgroup hate).

Hence, we aimed to investigate: 1) the potential effects of synchronous displays on perceived formidability and threat in a personally meaningful group context (soccer fans, a conceptual replication in a real-world context); 2) whether these effects influence behavioral decisions towards in- and outgroups (ingroup love vs. outgroup hate: extending previous work focusing on different ingroup vs outgroup behavior); and 3) whether identity fusion moderates these relationships (extending previous work to focus on the group affiliation dynamics of synchronous displays).

We seek to replicate tests for the coalitional signaling hypothesis and confirm whether synchronous displays are perceived as more formidable in general and whether it would increase perceived threat in outgroups. Moreover, we expand on previous research by exploring whether synchronous display also predicts behavioral effects when (a) the context involves meaningful social groups and (b) whether these effects are modulated by identity fusion.

1.6. Pre-registered hypotheses and predictions

Our hypotheses and analysis plan were pre-registered (see https://osf.io/x3vms/?view_only=a4fc6d92a9f54481b4fa812083aec1b1). Here, we state our hypotheses more succinctly. Focusing on the conceptual replication of Fessler and Holbrook (2016), we first predicted that:

1) Performers of synchronous chants will be perceived as more formidable, compared to performers of asynchronous chants, both by ingroups and outgroups.

Second, extending the previous work and including the group affiliation status, we predicted that:

2) The effect of synchronous chants on perceived threat will depend on group affiliation. We predicted that participants would report less perceived outgroup threat after synchronous ingroup chants compared to asynchronous ingroup chants, while outgroups would report higher perceived threat after listening to a synchronous outgroup chant.

Third, expanding the original paper that separated behavioral motivations towards ingroup vs outgroup members, we predicted that:

3) Synchronous chants will increase ingroup love (compared to selfish responses), but not outgroup hate responses, independent of group status.

Finally, integrating identity fusion and threat dynamics with synchrony, we predicted that:

4) Identity fusion in interaction with perceived threat will moderate the effects of synchrony on ingroup love and outgroup hate behaviors. We expected that highly fused participants who feel threatened will display either increased progroup (ingroup love vs selfish) or outgroup (outgroup hate vs selfish) behavior in the synchronous compared to the asynchronous condition, irrespective of the group (ingroups or rivals). We tested

whether group affiliation (ingroup vs outgroup status) mattered and included group status as an additional factor in our tests (see Hypothesis 2).

2. Methods

2.1. Participants

Participants were recruited from an online panel (NetQuest.com) from February 1st to February 8th, 2022. In exchange for participation, participants earned points that could be exchanged for gifts on the company's own website. In total, 1110 individuals accessed the survey. We excluded 339 participants who failed a control question (i.e., did not recognize the focal team's chant; see section 2.3). Hence, the final sample after filtering comprised N = 771, with 388 'ingroups' (supporters of the same club as in the audio stimuli: *n* synchronous condition = 203; *n* asynchronous condition = 185) and 383 'outgroups' (supporters of rival teams: *n* synchronous condition = 190; *n* asynchronous condition = 193). Sample demographics are displayed in Table 1. The study was approved by the [name redacted for peer-review] ethics committee (#66107017.7.0000.5249) and participants gave online informed consent before accessing the questionnaire.

We used the pwr.anova.test function of the R package pwr for sample size calculation (Champely, 2020). The power analysis focused on the test of H1 in the current paper, which was the conceptual replication of Fessler and Holbrook (2016). The original paper reported the main effect of synchrony on estimated physical formidability for two studies. Since this was our main hypothesis to be tested, we used the lower effect size reported in that paper ($\eta^2 = 0.02$, from their Study 1), a power of 0.80, and a significance level of 0.05, which estimated a minimum of 189 participants in each group (synchronous vs. asynchronous). Additional hypotheses involved interactions between variables (see below) that were not previously tested and therefore, we considered at least n = 378 participants to be required per level of synchronicity (synchronous vs. asynchronous).

Table 1: Final sample descriptive statistics per condition and group.

	Asynch		Synch	
Variable	Ingroup N = 185[1]	Rival N = 193[1]	Ingroup N = 203[1]	Rival N = 190[1]
Age	45 (+-14)	46 (+-14)	44 (+-13)	45 (+-14)
Sex				
Male	103 (56%)	120 (62%)	105 (52%)	110 (58%)
Female	82 (44%)	73 (38%)	98 (48%)	80 (42%)
Education				
Up to Middle school	6 (3.3%)	3 (1.6%)	9 (4.4%)	3 (1.6%)
Up to High school	73 (40%)	58 (30%)	75 (37%)	50 (26%)

Variable	Asynch		Synch	
	Ingroup N = 185[1]	Rival N = 193[1]	Ingroup N = 203[1]	Rival N = 190[1]
Up to college	69 (38%)	94 (49%)	80 (39%)	95 (50%)
Post-graduation incomplete/complete	36 (20%)	38 (20%)	39 (19%)	42 (22%)
Not informed	1	0 (0%)	0 (0%)	0 (0%)
Race				
White	98 (53%)	121 (63%)	120 (59%)	120 (63%)
Black	26 (14%)	10 (5.2%)	13 (6.4%)	9 (4.7%)
Asian	0 (0%)	3 (1.6%)	0 (0%)	0 (0%)
Brown/Pardo	59 (32%)	57 (30%)	67 (33%)	59 (31%)
Indigenous	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Not informed	2 (1.1%)	2 (1.0%)	3 (1.5%)	2 (1.1%)
Income[2]				
Class E (lowest)	57 (31%)	27 (14%)	53 (26%)	35 (19%)
Class D	51 (28%)	70 (36%)	66 (33%)	69 (37%)
Class C	56 (30%)	70 (36%)	70 (34%)	62 (33%)
Class B	18 (9.8%)	20 (10%)	10 (4.9%)	17 (9.0%)
Class A (highest)	2 (1.1%)	6 (3.1%)	4 (2.0%)	5 (2.7%)
Not informed	1	0 (0%)	0 (0%)	2

[1]Mean (+-SD); n (%)

[2] Based on the Brazilian Institute of Geography and Statistics, the agency responsible for the official census

2.2. Procedures

The online questionnaire was administered using Qualtrics (https://www.qualtrics.com). After providing informed consent, individuals responded to several filter criteria to select participants with relevant characteristics needed for the study. First, participants responded to whether they supported a selection of soccer clubs. Participants that supported *Flamengo* were considered ingroup members. Participants that supported rival clubs were asked whether they considered the focal group (*Flamengo*) as their main rival club (7-point likert scale from *not a rival at all* to *the biggest rival*), while fans of the focal group responded the same item regarding rivalry with the club used in the IPD-MD (see section 2.3.2). Although not explicitly pre-registered, we decided only

to analyze participants who self-reported Flamengo as a rival club to ensure that the stimuli were meaningful. Since the coalitional signaling hypothesis relates to groups in an agonistic context, it is relevant that either the synchronized group is composed of allies or enemies of the observer (Hagen & Bryant, 2003; Fessler & Holbrook, 2016). Therefore, those that did not support any club or did not consider *Flamengo* as a rival were not included in our analyses and all participants in the outgroup condition (N = 383) regarded the focal group as a rival.

After passing the filter questions, participants answered a socio-demographic questionnaire with questions regarding sex, age, education, race, income, and state of residency (Table 1). Next, they answered a series of soccer-related measures, including participants' sense of belongings to their fellow fans captured with a single-item identification measure (Postmes et al., 2013), the verbal identity fusion scale (Bortolini et al., 2018; Gómez et al., 2011) and a question regarding whether or not they were a member of a 'torcida organizada' (the Brazilian version of European ultras' groups of hardcore fans, traditionally called 'firms' for hooligans in the UK). The full questionnaire and soccer affiliation descriptive statistics (Table S1) are presented in the supplementary materials. Overall, participants were not "ultras" (less than 6% of the whole sample declared being part of a 'torcida organizada', an extreme fan group), but were highly identified with the fans of their club (single-item identification measure from 0 to 10 = 7.02; *SD* = +- 2.63; Table S1).

Participants were then randomly assigned to either the synchronous or asynchronous condition (see experimental stimuli at https://osf.io/x3vms/?view_only=a4fc6d92a9f54481b4fa812083aec1b1). After listening to the experimental stimulus, participants answered a control question to check that they recognized which club was supported by the fans in the audio (including five options: *Flamengo*, the focal group, and other popular Brazilian soccer clubs) and completed a manipulation check item on perceived synchrony on an 11-point Likert-type scale, ranging from 0 (*Completely out of time)* to 10 (*Perfectly in time*). After this manipulation check (see section 2.1. above for numbers of individuals excluded at this step), participants responded to the main outcome variables, as well as several additional control items (for details, see section 2.3.4 Control variables). At the end of the survey, individuals were debriefed and thanked for their participation.

2.3. Materials

2.3.1. Experimental stimuli

The study had a 2 (synchronous vs. asynchronous) x 2 (ingroup vs. rival) between-subjects factorial design. The synchronous and asynchronous audio clips were randomly assigned to participants, while the ingroup and rival levels were determined by participants' self-reported classification as an ingroup fan or rival. Prior to the stimulus page, participants were informed that they would listen to an audio clip of a group of chanting fans. Participants were advised to listen to the audio in a quiet environment with earphones, if possible. The audio consisted of a 60 second clip of people chanting the *Flamengo* anthem, a chant typically heard during *Flamengo* matches.

For the synchronous audio, seven voices singing together were recorded in a studio on four occasions and the four tracks were superposed to produce a "crowd effect". Moreover, to enhance the feeling of a crowd, we doubled each track and manipulated the pitch (two with five semitones above and two with five semitones below), totaling

eight superimposed tracks. A floor tom and claps marking the beat were added to increase the crowd feeling. Finally, we added a reverb effect and background crowd noise from a real stadium. For the asynchronous condition we delayed the floor tom by 1250ms and mismatched the eight tracks relative to each other: two voice tracks were delayed by 300ms; two by 400ms; two voice tracks advanced by 300ms; and the final two advanced by 400ms. In a pilot study (N = 184), participants rated perceived synchrony on a scale ranging from zero (*Completely out of time*) to 10 (*Perfectly in time*). The average perceived synchrony score for the synchronous condition was significantly higher (mean = 6.87 ± 2.43) than the asynchronous condition (3.37 ± 2.58; W = 1426, $p < .001$), indicating that our synchronicity manipulation was effective.

2.3.2. Outcome Measures

The formidability index was adapted from Fessler and Holbrook (2016) and composed of three 7-point Likert scale items on perceived group size (*How many individuals do you think were singing?* from 1-10 individuals to 60+ individuals), perceived height (*How tall on average do you think the fans in the audio are?* from *extremely below the average height* to *extremely above the average height*), and perceived muscularity on a pictorial scale with three avatars with different skin tones, to reduce race effects in the Brazilian context, which is ethnically and racially diverse (see full questionnaire at https://osf.io/x3vms/?view_only=a4fc6d92a9f54481b4fa812083aec1b1). The average of standardized ratings composed the formidability index, as in Fessler and Holbrook (2016). However, the reliability of this index was low (α = 0.38, 95%CI [0.31, 0.45]; omega = 0.42, 95%CI [0.32, 0.48]; average interitem correlation = 0.19). One possible reason for the low intercorrelations is that formidability may be a formative construct rather than a reflective construct. In a reflective construct logic, items represent indicators that are caused by a latent construct (e.g., an unmeasured underlying variable causes the behavioral responses to the survey items). Items in a reflective construct are conceptually exchangeable. In formative construct logic, on the other hand, conditionally independent items that are non-exchangeable cause an emerging effect. In our case, the size, muscularity, and height of individuals are mutually independent (see the low correlation between the measures), but the joint perception of these characteristics gives rise to the perception of formidability. Further probing of the nature of this construct requires additional data and is beyond the scope of our study. Considering our pre-registered analysis and the compositional aspects of this measure, we performed the analysis as predicted.

The perceived threat index was adapted from Jong et al. (2015) and comprised three 7-point Likert scale items (from *not at all* to *extremely*) referring to an outgroup target relevant to the individual (i.e., supporters of the rival club). The items measured perceived physical threat (*I feel that I could be physically attacked by [fans of a rival club]*), perceived verbal threat (*I feel that I could be verbally attacked by [fans of a rival club]*) and overall perceived threat (*I feel threatened by [fans of a rival club]*). The perceived threat index comprised the average standardized ratings, which showed good reliability (α = 0.83, 95%CI [0.81, 0.85]; omega = 0.84 95%CI [0.82, 0.86]; average interitem correlation = 0.62).

The behavioral outcome measure consisted of an adapted version of the IPD-MD game (Halevy et al., 2008), presented at the end of the questionnaire. This modified paradigm combines elements of the traditional Prisoner's Dilemma game, integrating intra-group and intergroup dynamics to explore the influence of group identity on cooperative

behavior. Participants are given three decision-making options: prioritize their own benefit only, prioritize the solely the benefit of their fellow club supporters, or simultaneously favor their ingroup while displaying hostility toward the rival outgroup to the detriment of their own benefit (i.e., losing money).

Participants were introduced to a hypothetical scenario where they were members of a three-person group, including two other supporters of the participants' club: "*In the next task, imagine that you are part of a group of three people: you and two other fellow fans. Your group will be paired with a group of three people who support a rival club. You will have three alternatives to decide from, each alternative having financial consequences for you, your fellow fans, and the three rival fans. Participants from rival teams will have comparable options*." Hence, although participants made decisions on their own (there was no interaction with other players), they were "playing" both with fellow fans (as part of their group) and with rivals.

After reading the instructions, participants then had to choose between one of three hypothetical scenarios: 1) keeping R$40 (~U$8 at the time of data collection) for themselves ("selfish decision") and giving nothing to the other ingroup members; 2) sharing with ingroup members, receiving R$20 each ("ingroup love"); or 3) contributing to ingroup members (R$20 each), while also taking R$20 away from each member of the rival team ("outgroup hate"). Therefore, in both ingroup love or outgroup hate decisions, participants would renounce R$20 (~U$4). They were explicitly told that the scenario was hypothetical.

2.3.3. Measured predictors

Identity fusion, which was one of the predictor variables in our analysis (see Section 2.4), was measured with the verbal identity fusion scale (Bortolini et al., 2018; Gómez et al., 2011), comprising seven 7-point Likert scale items (such as *I am one with the fans of my club* and *I have a deep emotional bond with the fans of my club,* anchored from *totally disagree* to *totally agree*). The measure showed good reliability (α = 0.89, 95%CI [0.88, 0.91]; omega = 0.90, 95%CI [0.88, 0.91]; average interitem correlation = 0.55).

2.3.4. Control variables

Participants also answered control questions on their participation: on which platform they answered the survey (PC/laptop, phone, other), how they listened to the audio (headphones, computer speakers, mobile audio, or other), where they were (at home, work, commuting, or other) ,and how many people were around them when the survey was taken (7-point Likert-type scale from "I was alone" to "+20 people around"). See Table S2 for descriptive statistics regarding context of participation. Overall, participants appeared to be in a relatively quiet place (i.e., mainly at home) but audio quality likely differed substantially due to a mixture of technology used by participants (i.e., mainly used audio from a PC/laptop or mobile phone).

2.4. Data analyses

Our hypotheses and analysis plan were pre-registered (https://osf.io/x3vms/?view_only=a4fc6d92a9f54481b4fa812083aec1b1). Here, we present updated analyses which improve on our originally pre-registered analyses. Specifically, we report an

integrated test which allowed us to reduce the suboptimal multiple tests that were anticipated in the original analysis plan, thereby controlling for the family wise error rate for each individual hypothesis but remaining true to the pre-registered confirmatory hypotheses and predictions.

To test the effect of synchrony on perceived formidability (H1) and threat (H2), we used two GLMs, similar to Fessler and Holbrook (2016). The independent variables were the condition (synchronous vs. asynchronous chants), the group (ingroup vs. rivals), and their interaction. The dependent variables were (1) the formidability index and (2) the perceived threat index. All variables were standardized ('z-scores') due to the different scales.

To test the effects of synchrony and identity fusion on the behavioral choices in the adapted version of the IPD-MD (H3), and the interaction of identity fusion and perceived threat with synchrony manipulations on behavior (H4), we ran a multinomial logistic regression examining the proportion of ingroup love and outgroup hate decisions, relative to selfish decisions. Predictors were the condition (synchronous vs asynchronous), group (ingroup vs. rivals), identity fusion, and perceived threat in a full-factorial model. Robustness and model assumptions checks are presented in the supplementary material.

For the anticipated exploratory analysis of the effects of sex and rivalry on perceived formidability and threat, we added these variables to the models described above. Since we only had audio stimuli of fans of one club, to inspect effects of rivalry on formidability and threat, we used a subset of the sample. Additionally, we conducted a further exploratory analysis not anticipated in the pre-registration, focusing on the effect of perceived synchrony on perceived formidability and threat. We briefly report these exploratory analysis in the manuscript and present details in the supplementary materials. However, we were not able to run the anticipated exploratory analysis on the differences between "ultras" and "regular fans", nor compare fans vs. non-fans due to our sample characteristics.

All analyses were performed using R Statistical Software (version 4.1.2; (R Core Team, 2021). Data handling, tables, figures and result reports were built with the packages from the *tidyverse* (version 1.3.1; (Wickham et al., 2019), as well as the packages *papaja* (version 0.1.0.9997; (Aust & Barth, 2020), *gtsummary* (version 1.5.2; (Sjoberg, Daniel et al., 2021), *flextable* (Gohel, 2022), effects (version 4.2.1; (Fox & Hong, 2009; Fox & Weisberg, 2019) and *ggstatsplot* (version 0.9.1; (Patil, 2021). Main analysis used the packages *lme4* (version 1.1.28;(Bates et al., 2015), *ufs* (version 0.5.2; (Peters & Gruijters, 2021), *psych* (version 2.1.9; (Revelle, 2021), *afex* (version 1.0.1; (Singmann et al., 2021) and *nnet* (version 7.3.17; (Venables & Ripley, 2002) For *post-hocs* of main effects and interactions, we used the package *emmeans*, which compares the estimated marginal means (EMMs) of different levels, taking in account unbalanced designs (version 1.7.2; (Lenth, 2022).

2.5. Data Availability

The materials, data and analysis code associated with this research are available at https://osf.io/x3vms/?view_only=a4fc6d92a9f54481b4fa812083aec1b1.

3. Results

3.1. Manipulation check

Overall, the synchronous manipulation worked for both ingroups and rivals (Figure S1). As expected, participants rated the fans in the "asynchronous" audio as singing more out of time (EMM ¿4.54, 95% CI ¿, 4.81¿) than in the "synchronous" audio (EMM ¿7.36, 95% CI ¿, 7.63¿; $F(1,767)=216.21$, $MSE=7.11$, $p<.001$, $\hat{\eta}^2_G=.220$). Moreover, ingroup members rated both audios as more synchronous (EMM ¿6.72, 95% CI ¿, 6.99¿) than rivals did (EMM ¿5.18, 95% CI ¿, 5.45¿; $F(1,767)=64.20$, $MSE=7.11$, $p<.001$, $\hat{\eta}^2_G=.077$). No interaction was observed between condition and group ($F(1,767)=0.06$, $MSE=7.11$, $p=.805$, $\hat{\eta}^2_G=.000$).

3.2. Effects of synchrony and group affiliation on perceived formidability

Our first hypothesis focused on the conceptual replicability of the original formidability results by Fessler and Holbrook (2016). There was a main effect of condition on standardized perceived formidability ($F(1,767)=7.93$, $MSE=0.45$, $p=.005$, $\hat{\eta}^2_G=.010$) with participants in the synchronous condition reporting increased perceived formidability (EMM ¿0.07, 95% CI ¿, 0.13¿), compared to the asynchronous condition (EMM ¿−0.07, 95% CI ¿, 0.00¿). This supports our first hypothesis that performers of synchronous chants would be perceived to be more formidable. There was a main effect for group on perceived formidability ($F(1,767)=16.39$, $MSE=0.45$, $p<.001$, $\hat{\eta}^2_G=.021$), with ingroup participants reporting increased formidability (EMM ¿0.10, 95% CI ¿, 0.16¿) compared to rivals (EMM ¿−0.10, 95% CI ¿, −0.03¿). There was no interaction between the group and condition ($F(1,767)<0.01$, $MSE=0.45$, $p=.969$, $\hat{\eta}^2_G=.000$; Figure 1).

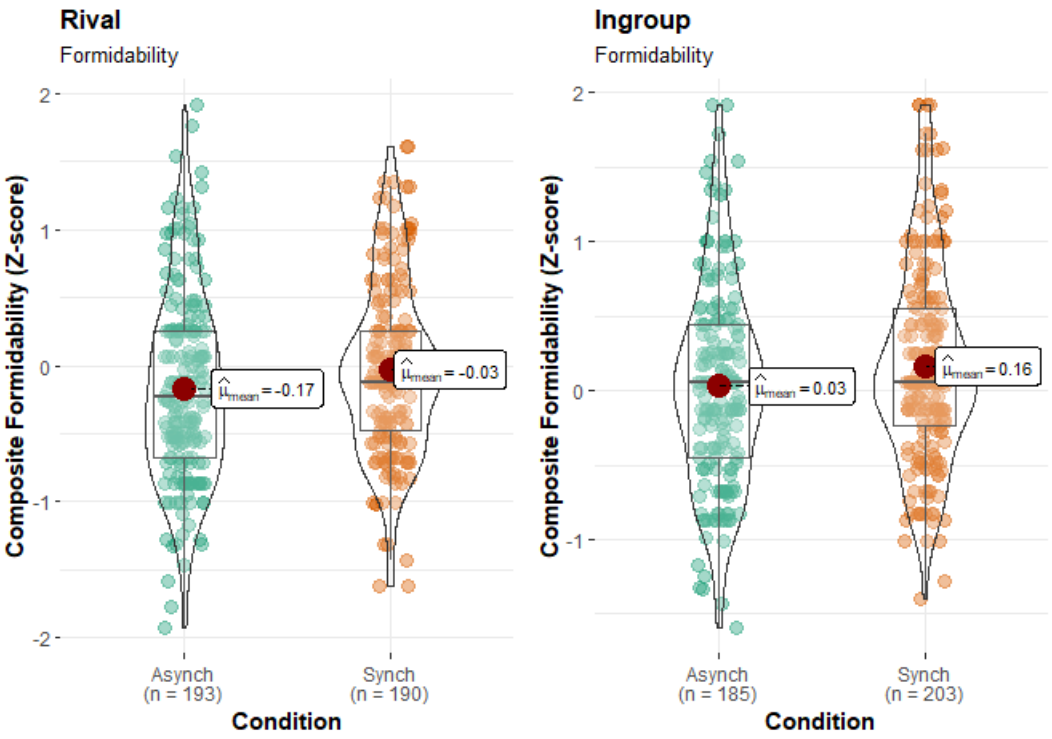

Figure 1: Perceived formidability for ingroups and rivals in synchronous and asynchronous conditions.

3.3. Effects of synchrony and group affiliation on perceived threat

Next, we tested the effects of the condition (synchronous vs. asynchronous) and group (ingroup vs. rival) on perceived threat. There was a significant main effect of group on the standardized (z-score) perceived threat score ($F(1,767)=36.58$, $MSE=0.71$, $p<.001$, $\hat{\eta}^2_G=.046$): ingroup members reported lower perceived threat (EMM ¿−0.18, 95% CI ¿, −0.10¿) than rivals (EMM ¿0.18, 95% CI ¿, 0.27¿). There were no significant main effects for the synchronous condition ($F(1,767)=1.73$, $MSE=0.71$, $p=.189$, $\hat{\eta}^2_G=.002$). Contrary to our predictions, the interaction between synchrony and group was not statistically significant ($F(1,767)=1.08$, $MSE=0.71$, $p=.300$, $\hat{\eta}^2_G=.001$; Figure 2). When chants were listened to by outgroups, the perceived threat was higher, but the level of synchrony did not appear to matter.

Following a suggestion from a reviewer, we further explored the effects of the synchronous condition on single items of the perceived formidability and threat measures. Analyzing separate ANOVAs, with each formidability item as a dependent variable (see Table S11 for a full description of results), we found that only “group size” showed a significant effect for the main effect of the condition (i.e., bigger group size reported for the synchronous condition). For the height and muscularity items, there was only one main effect of Group. Regarding the perceived threat items, when analyzed separately, the results were the same as the main analysis, indicating only a main effect of the group and no effect of the synchronous manipulation.

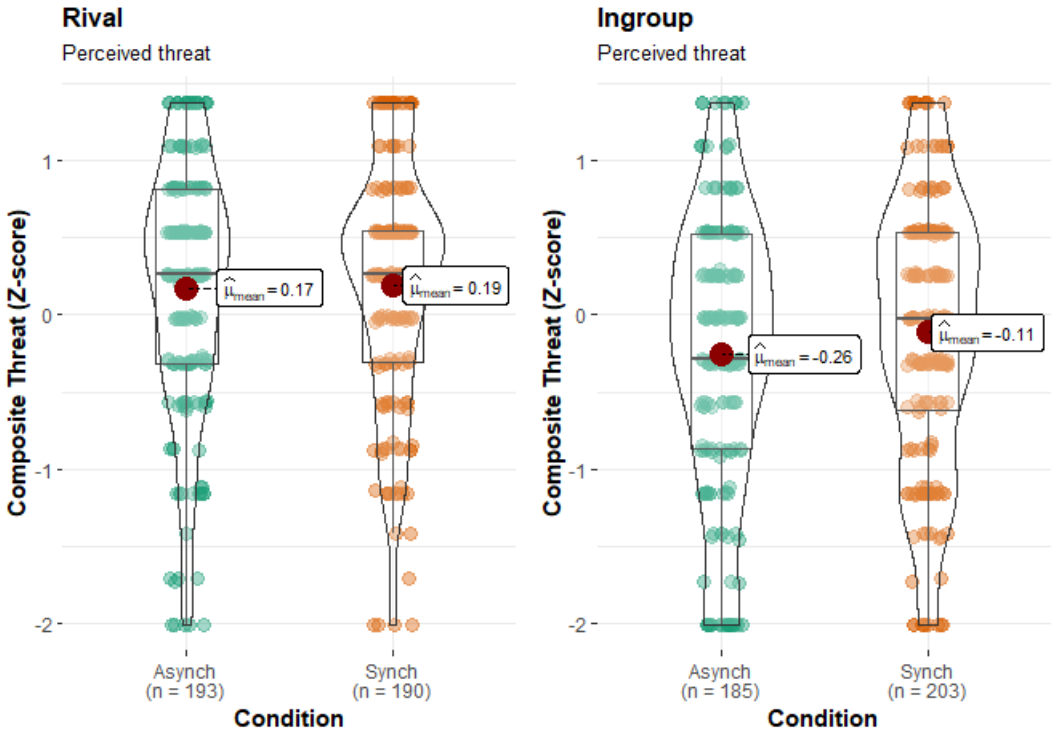

Figure 2: Perceived threat for ingroups and rivals in synchronous and asynchronous conditions.

3.4. Effects of synchrony and fusion on ingroup love, outgroup hate and selfish choices

The next hypothesis in our pre-registration expanded Fessler and Holbrook’s results by considering possible effects of the synchronous manipulation on behavioral choices involving ingroup-outgroup dynamics and the relationship with identity fusion and perceived threat. We expected increased progroup behavior (compared to selfish responses) after the synchronous chant. Moreover, in our final hypothesis, we expected that highly fused participants who perceived more threat would display either increased progroup behaviors (ingroup love vs selfish) or greater outgroup hostility (outgroup hate vs selfish) in the synchronous condition, compared to the asynchronous condition. To test these hypotheses, we fitted a multinomial regression model predicting each behavioral choice by Condition (synchronous vs. asynchronous), identity fusion, and perceived threat in a full-factorial model.

We observed one significant main effect for identity fusion (LR $\chi2(2, N=760) = 11.72$, $p = .003$) and a significant two-way interaction between identity fusion and perceived threat (LR $\chi2(2, N=760) = 7.60$, $p = .022$; Figure 3B). The statistics for all other non-significant effects are reported in Table S3. Against our predictions, there was no significant increase in ingroup love in the synchronous condition, even though the trend was in that direction. Still, supporting our predictions, we did not find an increase in outgroup hate in the synchronous condition (Figure 3A).

The interaction between identity fusion and perceived threat indicated that as perceived threat increased, highly fused individuals tended to decrease pro-group choices and increase outgroup hate choices (Figure 3B). This partially supports Hypothesis 4 in the sense that fused individuals with increased perceived threat were more likely to act with hostility towards outgroup members. However, contrary to our prediction, there was no three-way interaction between fusion, perceived threat, and manipulated synchrony. Nor did the interactive effects of perceived threat and fusion on the behavioral choices vary by our synchrony manipulation.

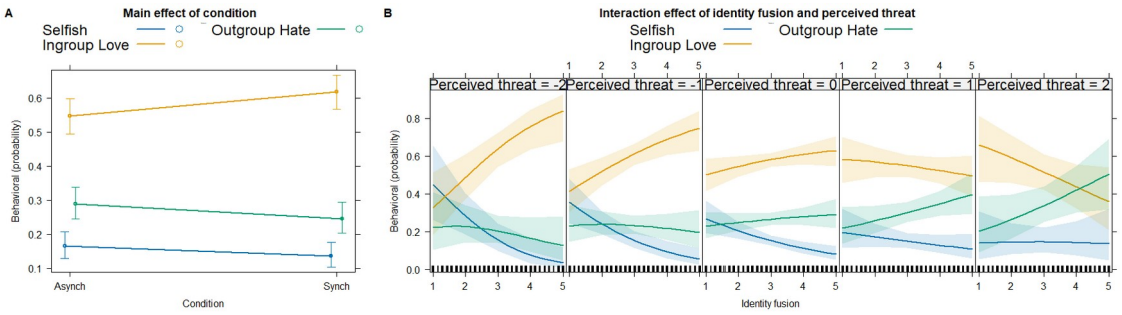

Figure 3: Multinomial regression modeled probabilities of each behavioral choice at the modified interpersonal dilemma for: a) the absence of a main effect of Condition (synchrony); and b) the interaction between identity fusion and perceived threat. Error bars represent 95% confidence intervals.

3.5. Exploratory analyses

3.5.1. Effects of sex and rivalry on perceived formidability

When adding sex to the previous model predicting formidability, the original results were maintained, with significant main effects of Group and Condition on perceived formidability as before. We also observed a significant main effect for sex (for detailed statistics please refer to the supplementary material, section 4.1). There were no three-way interaction effects involving the three variables, nor two-way interactions involving the synchrony manipulation (see Table S4 for all effects statistics). However, there was a significant interaction between Group and Sex indicating that female rivals reported increased formidability compared to male rivals. Moreover, ingroup males and females reported significantly increased formidability than male rivals (Table S4).

Regarding the effect of rivalry on perceived formidability, we considered only the subset of the sample with outgroups (i.e., rivals listening to a rival group). When predicting formidability by Condition and rivalry, there was a significant interaction

effect between rivalry and Condition (see Table S5 for all effects statistics). Simple slopes analysis indicated that rivals in the synchronous condition tended to perceive the synchronous audio as less formidable as rivalry increased, with the opposite pattern in the asynchronous condition (Fig. S4).

3.5.2. Effects of sex and rivalry on perceived threat

Regarding perceived threat, the original results remained similar after the addition of sex in the model, with a significant main effect for Group, but there was also a main effect for Sex on perceived threat. As in the original analysis, rivals reported increased perceived threat compared to ingroups, and females reported significantly increased perceived threat than males (for detailed statistics please refer to the supplementary material, section 4.3). There were no three-way interaction effects involving the three variables, nor two-way interactions (see Table S6 for all effects statistics).

When predicting perceived threat with rivalry and Condition, there were no significant main effects, nor interactions (see Table S7 for all effects statistics).

3.5.3. Effect of perceived synchrony on formidability, perceived threat, and behavior

The dispersion of perceived synchrony (Figure S1) indicated high variability in the sample, with some participants in the synchronous condition perceiving the audio as asynchronous and vice-versa. Hence, although the manipulation was evidenced to work overall, simply considering the "manipulation effect" in a model (i.e., the effect of condition) would not consider this observed variability of perceived synchrony in the two conditions. Therefore, we conducted additional exploratory analyses considering the effect of *perceived* synchrony on the dependent variables. This expands our *a priori* analysis plan and the original analyses in Fessler and Holbrook (2016) and could inform future confirmatory studies. We added perceived synchrony as a covariate to all the previous models to check whether the previous results would remain qualitatively the same when accounting for perception of synchrony. We present here an overview of these exploratory results and full details are reported in the supplementary material (section 4.5).

Most importantly, regarding the formidability effect, once perceived synchrony was considered in the model, the main effect of Condition predicting perceived formidability became non-significant. However, there were significant main effects for Group and perceived synchrony predicting perceived formidability (Table S8 and Fig S5). In other words, perceived synchrony appears to be the driver behind formidability effects. Adding synchrony as a covariate to the original models predicting perceived threat and behavioral choices in the IPD-MD did not change the previous results qualitatively in comparison to the original analysis (Table S10).

4. Discussion

Our study replicates and extends previous research into how group synchronous display affects perceptions of formidability, threat, and intergroup decision making. Using a sample with real group relevance, i.e., Brazilian soccer fans, we conceptually replicated parts of the original study by Fessler and Holbrook (2016), which showed that participants perceived synchronous displays as more formidable and threatening. Our

results provided mixed replication evidence for Fessler and Holbrook (2016). On the one hand, we found an effect of synchrony on perceived formidability of an outgroup among Brazilian soccer fans. On the other hand, there was no effect of perceived threat. We also expanded the previous study and added a behavioral choice task measuring ingroup cooperation and outgroup hate. There was no effect of synchronous stimuli on either ingroup cooperation or outgroup derogation. However, we found that highly fused participants who felt more threatened showed increased outgroup hate, independent of the synchrony manipulation.

4.1. Synchrony effects

We found confirmatory evidence that synchronous chants increased the perceived formidability of the chanting group. Although the effect had a small effect size, it conceptually replicated the original study and showed support for the coalition quality signaling hypothesis of group synchrony in an intergroup context (e.g., (Fessler & Holbrook, 2016; Hagen & Bryant, 2003; Reddish et al., 2013). It is noteworthy that as in Fessler and Holbrook (2016), there was no interaction with group affiliation even in our context involving meaningful groups. Moreover, the exploratory analysis demonstrating that *perceived* synchrony might be driving that effect, instead of manipulated synchrony *per se*, further indicate that the perception of synchrony might influence how formidable one evaluates a group. It also points to the relevance of both attention and signaling processes: individuals need to pay attention and perceive relevant signals in order to respond to them. Due to the exploratory aspect of this analysis, this result deserves further replication, but provides preliminary indication that future experimental interventions should account for explicit perception of synchrony and consider the use of obvious and clearly perceivable stimuli.

Contrary to our predictions, we did not find an effect of synchrony on the perceived threat. In the current study, we measured how threatened participants felt by rival fans in general (not directly related to the group portrayed in the stimuli). This was an attempt to generalize the potential effect of the synchrony manipulation on outgroups. Nevertheless, this effect was not found; we only observed an effect of group affiliation on perceived threat. Ingroup members reported lower perceived threat than rivals. Our real-world derived stimuli may not have provided sufficient information for our participants (e.g., visual, detailed context) to require them to update threat perceptions subjectively. In other words, listening to a chant that a participant may have heard thousands of times before within the context of an experimental study while one is safely at home is not likely to increase threat perceptions.

In contrast, the same chant in the context of a soccer match in a stadium or a street brawl after a match may result in different threat perceptions. Furthermore, the threat measure was highly abstract. Different from the formidability measure, which was directly related to an evaluation of the (a)synchronous audio, the threat measure was associated with a general feeling of being either physically or verbally attacked. Therefore, listening to one instance of a synchronous (vs asynchronous) chant in an experimental set-up may have been insufficient to change existing threat perceptions based on prior lived experience.

One pertinent area for future work is a greater exploration of the perceived formidability and threat construct itself. Although we found a significant effect of synchrony on formidability, the measure did not show high intercorrelations of its components.

Moreover, the exploratory results that separately analyzed the effect of synchrony on the individual formidability items indicated that group size might be the item driving the synchrony effect. This is in accordance with the coalitional signaling hypothesis and suggests that future studies should investigate which aspects of perceived formidability are modulated by synchronous displays.

Considering the issues we have found with the formidability measures reliability, it is clear that this concept needs further validation in future research. Many contemporary psychological constructs follow a reflective logic, in which observed indicators are manifest observations of a latent underlying variable (Edwards & Bagozzi, 2000; Kruis & Maris, 2016). However, in intergroup evolutionary contexts, a formative logic may warrant further attention, i.e., the convergence of weakly or un-related conditions may change the relevant dynamics and lead to shifts in both intergroup behavior and evolutionary transitions. For example, a small number of heavily armed soldiers or a large but unarmed mob may create similar levels of threat. The increasing presence of individual components (e.g., arms, number of individuals, orientation of the group) and intergroup dynamics (e.g., synchronized body language and chanting, clear leadership) create the impression of formidability in an intergroup context (Fessler & Holbrook, 2014, 2016; Launay et al., 2016).

Finally, we expanded previous studies by adding a decision-making task, which allowed us to tap into the effects of synchrony manipulation on inter-group behavior. We found no effects of the synchronous stimulus on ingroup and outgroup decisions. To some extent, these findings go against previous laboratory findings that highlight the role of synchrony on progroup behavior (for example, (Fairhurst et al., 2014; Jackson et al., 2018; Reddish et al., 2013). However, these studies focused on behavioral synchrony (e.g., moving together), while here, participants listened to (a)syncronous stimuli. Moreover, synchronous stimuli may not provide sufficient information to lead to outgroup derogation, rather further contextual information is required to engage in hostile behavior that could prove costly for self or group in terms of repercussions. Our results may point to the fact that it may be more difficult to temporally elicit or change behavioral reactions using naturally occurring groups, due to the presence of putatively stable reaction patterns attained over a lifetime of socialization.

4.2. Perceived threat, identity fusion, and formidability in real group contexts

In line with previous research (Buhrmester et al., 2015; Fredman et al., 2017; Klein & Bastian, 2022; Swann et al., 2014; Swann, Gómez, Dovidio, et al., 2010; Swann, Gómez, Huici, et al., 2010; Vázquez et al., 2020; Whitehouse, 2018; Whitehouse et al., 2014), we found compelling evidence that the interaction between identity fusion and perceived threat is related to increased hostile intergroup behaviors. Specifically, those individuals who were highly fused and perceived greater threat from the outgroup were more likely to punish members of other groups at a cost to themselves and their group. Although ingroup affiliative behavior was otherwise more frequent than outgroup hate in general, for highly fused individuals who perceived high levels of intergroup threat, the behavioral pattern reversed, and outgroup hostility responses became dominant. This pattern may explain several other real-world effects, ranging from extreme behaviors commonly seen in warfare to religious fanaticism.

We pre-registered our hypotheses, therefore providing some reassurance to the observed patterns. However, contrary to our predictions, the interaction between fusion and

perceived threat was not influenced by the synchrony manipulation. As described above, a single observation of a synchronous signal (of either an ingroup or outgroup) may not be sufficient to shift long-term socialization patterns, nor did it influence perceived threat. Rather, as our findings suggest, we hypothesize that the mechanism driving hostile intergroup behavior mainly concerns how one feels threatened coupled with a visceral bonding to the group.

Although long-lasting group affiliations might create stable threat perceptions that are resilient to artificial experimental manipulations, it is still not clear how real-world demonstrations affect real-time perceived threat. Future research is needed to investigate this issue. For instance, experiencing a group of highly coordinated rival fans before a match could heighten existing threat perception if an individual has past direct experience of these fans behaving aggressively, but not so if the rivals have a reputation of being peaceful. Soccer teams themselves already use the pre-match ritual of singing the national anthem prior to national games, and managers may want to take note of how much more formidable their team is likely to appear to their rivals when chanting in unison!

Fusion most strongly predicts violent self-sacrifice after experiencing a threat. If security and police forces can develop strong relationships with pivotal, fused group members then there is potential to understand what environmental stimuli are threatening, and why, and to reduce their effects. On the other hand, fusion also predicts peaceful forms of pro-group action. By framing societally negative behaviors as being damaging to the group and having the group signal that these behaviors are unwanted, we may see improvements in group dynamics that revolve around the fused individual's desire to do what is best for the group.

Limitations

As this study was conducted online, we could not control the environment in which participants completed the research. We requested that participants were in a quiet place and to use headphones, if possible. However, participants had access to devices with variable audio quality and some reported presumably low sound quality devices (i.e., mobile phones or laptops). This may have impacted the stimuli's effects as the audio would have been less immersive and realistic than in a high-quality audio device. Hence, we propose that this study reports an underestimation of the effects of listening to synchronous group chanting. We also need to consider the possibility that the asynchronous condition not only symbolized a less cohesive or less synchronous group but was simply an unpleasant condition to be in, which led to the behaviors we observed.

This study points to a potential issue with the composite scores used for the formidability and threat measures. One limitation of this study is that physical and verbal abuse are not teased apart by our measures. We would encourage future researchers to explore the different aspects of such constructs and contrast the effects of synchronous displays separately.

Another issue with this online study is that our recruitment strategy may have suffered from self-selection bias. We cannot be certain that soccer fans willing to participate in an online survey are truly representative of all soccer fans (for example, there was an extremely low number of fans who were members of *torcidas organizadas*, extreme

fans, although these are already a minority). Moreover, our participants only listened to chants from one team, due to the practicalities of creating authentic fan chants from multiple clubs, we could not test whether the same effect would generalize to other groups of soccer fans.

Overall, the demographics appeared to reflect wider Brazilian society, therefore our sample can be considered to largely reflect broader Brazilian population. As the focus was on soccer fans specifically, we do not know whether a sample that approximates national representativeness is reflective of the dynamics within the specific sports context. We suggest caution in generalizing our novel findings before they are replicated in other cultural contexts.

Conclusions

We found strong evidence that exposure to synchronous ingroup behaviors, i.e., chanting encourages more pro-group behavior. Contrary to previous suggestions, outgroups exposed to a rival group's synchronous behavior did not become more hostile, unless the participant was highly fused to the ingroup and perceived a high level of threat. These experimental findings, using stimuli with high ecological validity, were associated with allocation behaviors among participants with natural affiliations, i.e., to a highly valued soccer club. We anticipate that the findings will scale up to other real-world contexts, where synchronous behaviors are common, such as military or religious groups. Understanding our feelings toward groups who behave more or less synchronously has the potential to translate to high impact work around conflict resolution and strategies for the prevention of intergroup conflict.

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