Missing “the little things that make you human”:

Medical students’ experiences of digital teaching and learning

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Abstract

Recent decades have seen a significant global scale-up in the training of doctors with an increased pressure on training resources. This thesis began with a question about how scalable digital materials could be designed to support medical students' learning of clinical reasoning - the process of making informed judgements about the likely causes and best action to be taken when faced with a clinical problem. My initial research was underpinned by an assumption that it would be possible to design digital tools that students would find as motivating as face-to-face encounters. However, my early empirical work using design research raised doubts about that and caused me to take a step back and examine medical students' digital learning engagement more generally.

In this thesis, I ask the question: why, and in what ways, is digital learning engagement different from face-to-face learning engagement? I test a hypothesis about digital learning engagement that is derived from Silvan Tomkins' Script Theory, using a series of repertory grid interviews with clinical medical students. I have taken an ontological position on the human mind, arguing that it is an embodied entity that actively scans the environment looking for meaning, and in which learning is driven by curiosity but motivated by the affective response of interest-excitement. Although Tomkins provides my main theoretical framework, I have triangulated his ideas with George Kelly's Personal Construct Psychology, partly to add extra metaphorical depth, but also because Kelly's theory offers a logic of enquiry and a method that I did not find in Tomkins. I also draw on Alexander Bain's ontological description of the embodied mind, but update this with more contemporary ideas about perception and curiosity.

My script theoretical hypothesis was not supported by the empirical data, because it was based on a false assumption that students' engagement with digital learning was superficial. However, several important findings emerged. Medical students, on the whole, appreciate the convenience and safety of digital learning but do not actually enjoy it. Students experience digital learning as lonely and perceptually poor, and they explicitly link this to difficulty in sustaining attention. I contextualise these findings within the idea of the embodied, curious, affect-susceptible mind, and argue that a sense of place is important for learning, as is the real presence of others. Learning in three-dimensional "real" worlds allows students to derive meanings from place and person that support the affective response of interest-excitement. This, in turn, supports sustained attention.

I argue that when considering learning media, we should distinguish between the efficient and the human, identifying the contexts in which the efficiency gains of digital media outweigh the de-humanising nature of digital learning, and continuing to value the human attributes of face-to-face teaching and learning.

1. Introduction

This thesis began with a question about how digital materials can best support the teaching of clinical reasoning to medical students, but it developed as a more general enquiry into how medical students feel about digital teaching, in which I develop a theory of learning engagement that shows how the perceptual qualities of two-dimensional digital learning media may influence interest and engagement, and be ultimately experienced as de-humanising.

The initial focus on clinical reasoning was important to me personally. I had spent about 30 years in hospital practice, much of it in health systems considerably less well resourced than the UK's National Health Service, and the use of informed judgment, based on clinical history and examination, to limit and then adjudicate between likely diagnoses and appropriate management strategies had seemed to me the defining role of a doctor. However, although learning this type of reasoning is not a trivial task, it seems to be ever less salient and valued in medical curricula. Repeated calls for "reform" - a loaded word - in medical education, driven by persistent health inequalities and dissatisfaction with healthcare systems worldwide (Frenk et al., 2010; Whitehead, C.R et al., 2013) have resulted in increased emphases on skills such as communication and teamwork (General Medical Council, 2018), the introduction of the medical humanities in a questionable attempt to create more humane doctors (Downie, 2003), and confusion about what medical education should be achieving (Hawick et al., 2017). In parallel with this reduced emphasis on clinical skills in curriculum design, medical students spend less time with real patients who have real problems, because patients spend less time in

hospital, clinicians face greater time pressures, and there are concerns about patients' expectations and safety when students are involved in their care (Swanwick, 2019).

It was, and still is, my position that teaching medical students to produce a well-reasoned working diagnosis and management plan before ordering investigations should remain the central goal of the medical curriculum. The alternative to patient management plans that are directed towards a clinically-determined, most-likely diagnosis is a relatively undirected approach to the investigation of symptoms and the consequences of this are over-use of resources and over-diagnosis of "diseases" that may never have caused problems in the patient's lifetime (Kale & Korenstein, 2018). A patient may also receive a battery of tests without no guarantee of an answer to the question "what is wrong, and what should be done next?" Adequate clinical reasoning skills are therefore not only a professional imperative - I believe that patients still, rightly, expect them of the profession - but they are of economic value because they mean that healthcare resources are more likely to be used wisely.

However, even if the argument for keeping clinical decision-making and problem-solving at the centre of the curriculum is accepted, the problem of how to deliver this teaching with increasing student numbers and reduced access to real patients remains. Many countries worldwide, but particularly low and middle income countries (Mullan et al., 2011), have been expanding their health workforces and enrolling more students into medical training programmes and this has had an impact on students' access to teaching resources (Mengistu et al., 2017). The scalability of digital learning platforms makes them particularly attractive in contexts where access to patients or tutors is limited, but it is not

clear how digital methods can best be used to support the learning of clinical reasoning, which has traditionally taken place with real patients in clinics or at the bedside (Kassirer, 2010), and there is a very real concern about engagement with online teaching resources in higher education generally: even contemporary undergraduate students, who are often assumed to be "digital natives" (Prensky, 2001) often express a preference for face-to-face teaching (Kemp & Grieve, 2014; Pedrosa-de-Jesus et al., 2014; Raupach et al., 2009); completion rates for high quality, free courses are disappointingly low (Laurillard & Kennedy, 2017; Terras & Ramsay, 2015) and many educators report minimal use of online discussion forums (Lwoga, 2014; Morrison, 2012; Nandi et al., 2011). When using digital materials students often multi-task, while over-estimating their ability to do so effectively (May & Elder, 2018). They also read differently online, with a significant drop in reading performance when doing so (Clinton, 2019; Delgado et al., 2018). The mechanism for this deterioration in reading performance is unclear: while both young and old express a preference for paper reading, objective measures of cognitive effort suggest no cognitive advantage for paper (Kretzschmar et al., 2013). It seems that many of us just *like* reading from paper and *prefer* face-to-face teaching. These preferences require an explanation if digital learning engagement is to be understood and the scalability of digital teaching properly exploited.

The starting point for this thesis was a question about how digital materials could best be designed to support the teaching of clinical reasoning. That question stimulated two pieces of empirical work that, in the interests of clarity, are not reported in full here, but which are worth summarising because they provide justification for the more general enquiry into learning engagement that followed.

The pivot towards remote, digital teaching that happened during the Covid-19 pandemic early in 2020 provided a useful opportunity to study the affordances, use of, and reaction to digital teaching. I conducted a scoping review of strategies to provide digital clinical teaching during the first year of the pandemic, together with an exploratory thematic analysis (Voss et al., 2023) [see Appendix A]. Digital teaching was found useful for supporting students' learning of remote consultation skills in the growing field of telehealth, and in fields that rely on visualisation such as radiology and dermatology, but digital strategies were generally seen as poor substitutes for face-to-face clinical teaching. Digital cases were felt to lack complexity and the instructor input required to keep students interested was considerable, making digital strategies less available to under-resourced training systems. It seemed that the design of scalable digital materials that demanded the cognitive skills of clinical reasoning while also keeping students engaged was a worthwhile effort.

The scoping review was followed by design research (Voss, 2023) [see Appendix B] in which I used a process of rapid prototyping and testing of digital clinical learning designs, using a game-based approach to address the engagement problem (Aguilar et al., 2018; Fishman & Niemer, 2020; Gee, 2005). Design research is intended to build theory during the design process, and it is the theory building that makes it research rather than simple design (Cobb et al., 2003). However, there is a lack of clarity about what sort of theory can be built or tested and how this should be done (DiSessa & Cobb, 2004). As a result, design research is often under-theorised, resulting in what one author referred to as: "elephantine effort[s] result[ing] in the birth of mouse-like insights in their contribution to

educational knowledge" (Dede, 2004). To build theory about learning engagement, I chose to use Sandoval's "conjecture mapping" approach (Sandoval, 2014) in which the assumptions about how design features produce outcomes are made explicit in the form of design conjectures and theoretical conjectures. However, after testing three prototypes, it became apparent that individual links between design features, explanatory mechanisms and outcomes could not be isolated. The "whole system" nature of design research (Brown, 1992) means that, saving the emergence and recognition of a serendipitous theoretical finding, it is powered only to establish that a set of design features produces a particular outcome in a particular context. In other words, *that* a design "works", not *why* it "works." Design research's weakness in identifying and testing individual causal mechanisms necessarily limits its use in generating transferable findings.

Another, more practical, problem emerged during the design research phase. Although the design features that should have produced learning engagement were apparently successfully instantiated, use of the learning tool outside the incentivised research context was minimal. I received a single, glowing, feedback report from the third prototype, but nobody else used the tool, despite enthusiastically expressed intentions to do so. This inertia was in marked contrast to the hunger for face-to-face learning that I had observed in the same group in the clinical environment, and it raised the possibility that there is something inherent to the digital medium that stops learners from engaging. Investigating how learners really feel about digital learning, and why it may be off-putting, seemed a more interesting direction of enquiry than forcing some "mouse-like insights" from the design experiment by using more persistent requests for engagement

and larger incentives. A new research question was formulated: **why, and in what ways, is digital learning engagement different from face-to-face learning engagement?**

In order to answer this question, some metaphysical problems immediately present themselves: what sort of a thing is learning engagement? What are its properties and antecedents? Csikszentmihalyi describes a rather extreme form of human immersion in experience that he calls “flow”, in which “all the contents of consciousness are in harmony with each other, and with the goals that define the person's self” (Csikszentmihalyi, 1988, p. 28), but what does learning engagement look like on a more mundane level? And, perhaps more fundamentally, how should we think about the engaged, learning, human mind? Metatheoretical questions dogged the early development of this thesis, from trying to understand the complaints about under-theorisation in design research, game-based learning and medical education research in general; to my bewilderment when, after many years of enjoying the stable, coherent theories of clinical medicine, I was faced with social science theories in which there are no uncontested paradigms and a variety of conflicting and overlapping explanations must be sifted through to see what might be useful. It is therefore appropriate that the first of three sections in this thesis is theoretical in nature. In the first chapter, I examine the nature of theory and establish the parameters by which I chose to evaluate and select theories, and I argue that the nature and properties of the concepts being studied – in this case learning engagement and the learning mind - must be made explicit. In the next chapter, I examine and justify an ontological theory of the learning mind, arguing that the mind is embodied and inherently curious. Following this I look at two substantive theories of human thought: Silvan Tomkins’ Script and Affect Theories, which offer a compelling

explanation of motivation; and George Kelly's Personal Construct Theory, which offers a logic of enquiry for examining the structure of thinking. I establish an epistemic justification for triangulating these two theories and propose using Kelly's Repertory Grid Test to examine script theoretical hypotheses derived from Tomkins.

The second part of the thesis presents my empirical work. I describe a series of repertory grid interviews in which clinical medical students were asked to make comparisons between face-to-face and digital learning activities. During these discussions, I have understood "digital learning" to refer to the whole ecology of two dimensional, screen-based digital resources that clinical students routinely used, particularly during the Covid-19 pandemic when the pivot to the digital was necessarily rapid and somewhat unplanned. There is therefore a particular focus on live video-conferenced discussions and asynchronous recorded lectures and tutorials. We did not discuss some of the more sophisticated three dimensional digital tools, such as immersive virtual environments and the use of holography, and I make no claims about those. The rich qualitative data about two dimensional digital media that the repertory grid technique generated was combined with quantitative grid data to test (and eventually reject) a script theoretical hypothesis, which proposed that "superficial" digital learning engagement was fostered by other activities in the digital environment. However, other interesting findings emerged, such as the impoverished sensory and perceptual experiences that students reported with digital learning, the negative affective response that is associated with this, and students' comments about how this influences their interest.

In the third part of the thesis, I examine what these findings mean for the idea of the embodied, curious mind. Although I rejected the script theoretical hypothesis I had

derived from Tomkins, many of his ideas were supported by my empirical findings, including the importance of place in providing meaning, and the role of affective response in providing motivation. I suggest that the idea of the embodied, curious mind should be extended to include affective response; that the positive affect of interest-excitement is generated when the curious mind finds answers that satisfy its goals; and that interest-excitement is motivating and will direct attention to objects of the interesting-exciting kind. I propose this as an explanation of sustained attention. The theory is easily understood in terms of intellectual curiosity, but is more interesting when applied to perceptual curiosity.

Drawing on the students' comments, and supporting them with descriptions from some important works of modern literature, I argue that the embodied, curious mind asks questions about the physical and social learning environment such as: what is this place and what does it mean to me? Who is that person and what does it mean to them? Who is that person and what do they mean to me? Curiosity about our environment is deeply embedded in us, and in other animals, because it is a drive with survival benefit. Perceptual curiosity is very much a part of being a learning human and removing these meanings by neutralising the perceptual experience and asking students to direct their intellectual curiosity only to screen-based content, will be experienced as demotivating and, as more than one student indicated, de-humanising.

Finally, I revisit the use of digital tools in medical education. I acknowledge their convenience and scalability, but suggest that efficiency in teaching and learning may come at the cost of the human learning experience. Learning designers may do well to accept the anomie associated with digital learning, and to maximise efficiency gains by

optimising quality of content and ease of navigation, following existing recommendations about segmentation of content, and avoiding gimmicks such as game features. Efficiency gains, such as time flexibility, may be a priority for some user groups, such as post graduate, professional learners, while the full, human learning experience may be more important for full time students. Face-to-face learning for medical students should continue to be valued, and this work raises the question of whether the indiscriminate use of digital media may result in de-humanising learning experiences and, therefore, the training of de-humanised doctors.

2. Meta-theory

There is an expectation that doctoral research is underpinned by a theoretical framework, although doctoral candidates often find it difficult to choose and use theories (C. Grant & Osanloo, 2015; Wisker, 2015), and "under-theorisation" is a pervasive criticism, not only of health professions education (Cook et al., 2008; Gentry et al., 2019; van Gaalen et al., 2021), but also of social science research more broadly (Abend, 2008). Part of the problem may be uncertainty about what a theory actually is, and what function it is expected to perform in a research project. Getting to grips with this was certainly something I found challenging, having spent most of my adult life in clinical medicine, which is informed by a stable knowledge of the relationships between variables, and a coherent set of beliefs about the mechanisms that explain physiological and pathological phenomena. In the early work for this thesis, I explored a number of contemporary theories of digital learning and found them unsatisfactory, for reasons that will be explained at the end of this chapter, eventually choosing two rather unfashionable theorists one of whom is, I believe, unfairly neglected. I will justify this choice in this chapter, in which I specify the work that theory must do in empirical enquiry and establish a position on the criteria for a useful theory. The theories I eventually chose will be discussed in more detail in Chapter 4.

In the first part of the chapter, I will describe two problems with choosing and using theory. The first of these is uncertainty about what the word theory means, the second is the tendency to use empirical data to verify, rather than to test and build theory in social research. To address these problems, I will examine the relationship between theory and

empirical data, with a focus on the work that theory should do in empirical enquiry. This will lead to a position on what constitutes a useful theory. Finally I will explain why I rejected some of the more obvious, contemporary, theoretical frameworks.

The problems of theory

One of the difficulties encountered when choosing and using a theory for educational research, is that the meaning of "theory" is difficult to pin down. Abend (2008) describes seven different meanings of the word theory in sociological research, identifying them as theories$_{1\text{-}7}$, and arguing that different usage results in "pseudo-disagreements, conceptual muddles and even downright miscommunication" Abend (2008, p. 184). Abend's comments about "conceptual muddles" and "miscommunication" echo earlier comments made by Merton (1957/1968) who, writing about social research 60 years ago, stated:

> *"like so many words that are bandied about, the word theory threatens to become meaningless. Because its referents are so diverse – including everything from minor working hypotheses, through comprehensive but unordered speculations, to axiomatic systems of thought – use of the word often obscures rather than creates understanding " (p38).*

Abend frames the problem as a semantic one, and he argues that the solution is a semantic pluralism, in which multiple understandings of the word theory are allowed, but their use is specified. However, Merton frames the problem in terms of the "level" at which the term theory is used, with "axiomatic systems of thought" representing a very high level of generalisation, while "minor working hypotheses" represent theories that are specific to a particular context. Productive theory is, Merton suggests, in the "middle range" between these two levels of generalisability, lying between grand theories that are:

> *too remote from particular classes of social behavior, organization and change to account for what is observed" and "detailed orderly descriptions of particulars that are not generalized at all. (Merton, 1968, p. 38)*

The concept of the theory's "proximity" to the data is an important one that I will return to later, but for this account I think it is useful to draw on Epstein's scheme and make a distinction between theories that explain the world around us, and which have empirical interpretations, and philosophical theories about the nature of objects, how we can know about them, and why they are important to us. The main focus of this chapter is the first type, the "explanatory" theory, with philosophical theories discussed towards the end of the chapter.

A second problem is posed by the choice and use of a theory in a way that generates new knowledge in the field of interest, rather than accommodating data that are "already known and taken into account in formulating the theories themselves" (Chakravartty, 2017). Glaser and Strauss argued that the tendency for post-war sociological research to verify "great man theories" had stifled new insights and theoretical developments (Glaser & Strauss, 1967/1999). They proposed instead that researchers should develop "grounded theories" in which "most hypotheses and concepts not only come from the data, but are systematically worked out in relation to the data during the course of the research" (Glaser & Strauss, 1967/1999, p. 6), and that researchers should ignore existing literature and theory, in order to avoid "contamination" of any freshly emerging theory (Glaser & Strauss, 1967/1999, p. 37). Although grounded theory has been widely used in medical education research (Harris, 2003; Watling & Lingard, 2012), use of the grounded

approach means that any advantages of using an established theoretical framework are lost. To understand whether that presents a problem it is necessary to examine the relationship between data and theory, and the function of theory in empirical enquiry.

The relationship between data and theory

We do research in order to explain and predict the world around us and, at least in scientific research, this involves a search for consistent relationships between variables, known as "regularities". When these relationships are repeatedly observed in many instances, they can be expressed as empirical laws[1]; either universal laws when the regularity hold in all cases, or as "statistical" laws where the regularity occurs in a proportion of cases (Carnap, 1966/1995). An example of a universal law is "if the blood supply to a muscle is occluded, it will necrose." Statistical laws can either be expressed as a specified percentage, or as some other quantitative statement, for example "80% of patients will have a complete radiological response to this chemotherapeutic agent" or "most students are upset by failing an exam." A theory[2] can be conceived as an explanation that links different empirical laws, Carnap (1966/1995) refers to a theory as a type of hypothesis about the relationship between empirical laws that cannot be observed, but that must be tested by deriving and testing other regularities from it. Theories may be useful for explaining the relationship between regularities, but they are most useful when they can be used to predict new regularities in the world. The relationship between data and theory can be summarised as follows:

- Empirical data are observed for regularities ("empirical laws")

[1] A law is a statement about an observed regularity, but I use the terms synonymously here

[2] Carnap refers to theories as "theoretical laws." I will use the term theory.

- An explanation for the relationship between different regularities is hypothesised, this hypothesis is a theory
- A good theory predicts new regularities
- The newly predicted regularities can be tested against new empirical data

Some criteria for a good theory can already be identified: a good theory should be derived from reliable empirical data, have explanatory power, and it should be possible to derive new, empirically testable hypotheses from it. It is also clear that the theory needs to be close enough to the data to explain the regularities found there, but is also needs to be far enough away to allow the generation of new hypotheses. These types of theories are, by definition, Merton's theories of the middle range.

What established theories offer over "grounded theories"

Of course, the relationship between data and theory described above could equally well apply to grounded approaches, in which new theory is derived directly from data, because there is no reason why a grounded theory could not generate new hypotheses for further testing. However, there are advantages to using a well selected, established theory.

Firstly, there is a valid argument, drawn from Bayesian probability, that using a good theory in hypothesis-testing research reduces the chance of false positive results, because the prior probability of a true hypothesis is increased. Conversely, if hypotheses are derived from implausible theories or are atheoretical, the prior probability of a *false* hypothesis is increased, and a statistically significant finding on testing is therefore more

likely to be the result of the false positive rate that is inherent in all tests (Bird, 2021). This is well illustrated by investigators who use an exploratory approach to scrape big data from the internet deliberately to identify and present spurious correlations (Vigen, n.d.), and we instantly recognise that these correlations have happened by chance because we can think of no plausible mechanism by which they might reflect a causal relationship. Bird (2021) suggests that high rates of false hypotheses are responsible for the replication crisis, at least in quantitative research, and that the use of good theories should be considered part of the solution. By identifying plausible mechanisms, they increase the prior probability of a true finding and reduce the rate of false positive results.

Secondly, when using exploratory approaches, theories add structure (Casula et al., 2021) and transparency (Dixon-Woods, 2011) to both the coding of data and its interpretation. They also allow inferences to be drawn from data that cannot be drawn from isolated, unexpected correlations, because findings can be mapped on to and compared with existing explanations of relationships between concepts.

A final argument can be made in support of the use of theory-led enquiry: if a researcher finds theory that is imaginative and subjectively appealing, the theory may be worth exploring, testing, and possibly extending, on its own merit.

Avoiding the verification trap when using theory

Glaser and Strauss' concerns about the sterility of research that produces "verification rhetoric" is valid, but there are some contradictions between their claim that researchers should try to avoid contamination of their emerging grounded theory by existing theories,

and their acknowledgement that no researcher approaches a problem with a "clean slate":

> *the trick is to line up what one takes as theoretically possible or probable with what one is finding in the field. Such existing sources of insight are to be cultivated, though not at the expense of insights generated by the qualitative research, which are still closer to the data. A combination of both is definitely desirable.* (Glaser & Strauss, 1967/1999, p. 253)

Gilgun (2015) explored these contradictions and suggested that Grounded Theory is not, as Glaser and Strauss argued, the best alternative to research that verifies and makes data fit "great man theories" and thereby stifles fresh theorising. Instead, she argued for the use of theory in a flexible manner, testing, modifying and possibly, ultimately rejecting it. She called this approach "Deductive Qualitative Analysis" (Gilgun, 2015), and a similar approach was used by Carroll, (2011) who described the use of a "best fit framework" to structure a qualitative synthesis of the views of people taking cancer chemoprophylaxis. The flexible use of theory was also proposed by Merton

> *It is my central thesis that empirical research goes far beyond the passive role of verifying and testing theory: it does more than confirm or refute hypotheses. Research plays an active role: it performs at least four major functions which help shape the development of theory. It initiates, it reformulates, it deflects and it clarifies theory (Merton 1957/168 p157)*

It seems that if theory is used flexibly, and with an open mind in exploratory research, it does not have to stifle the emergence of new ideas, and can offer the "best of both worlds", profiting from the advantages of theory-informed enquiry, while allowing new ideas to emerge from the data.

Characteristics of good theory

Some characteristics of a good theory – at least for empirical work - emerge from this discussion. Most importantly, it should be possible to derive and test new hypotheses

from it. If a theory cannot be tested, either logically or empirically, it is not epistemically vulnerable and should perhaps better be called speculation (Chakravartty, 2017). Deriving testable hypotheses requires that the theory should be close enough to the data, and this usually means a theory in the middle-range, or theories from which statements in the middle range can be derived.

Simpler theories are also generally preferred, partly because we have an intrinsic bias towards simplicity, but also because there is a more contested claim that simpler theories are more likely to be generalisable and therefore true (Domingos, 1999; Quine, 1963).

Theories in the scientific sense must also be logically consistent – that is, it should be possible for all statements in the theory to be true at the same time (Baggini & Fosl, 2010). Finally, the role of our subjective inclinations needs to be acknowledged: the flash of insight produced by the discovery of a theory that seems to illuminate and clarify our thoughts must, to some extent, be a product of our existing thinking.

These, then are the criteria for a good theory: it should offer a plausible explanation for a phenomenon; it is empirically supported; it can be used to generate testable hypotheses and thereby produce new knowledge; and, it should be subjectively appealing, logically consistent and preferably simple. As I searched for a theory of learning engagement, I found that Silvan Tomkins' Affect and Script Theories (S. S. Tomkins, 2008a) met all these criteria, and his work will be presented in detail in Chapter 4, together with another useful theory – George Kelly's Personal Construct Psychology (Kelly, 1955). However, it is

also probably necessary to indicate why I rejected some of the more conventional, contemporary theories of human-digital interaction.

The dominant contemporary theories of online learning (Garrison et al., 1999; Harasim, 2000; Siemens, 2005) focus on how students connect with each other and with web-based knowledge, but I found these unsatisfactory because they start from an assumption that students *will* connect and they explain neither students' continuing preference for face-to-face teaching in the digital age (Kemp & Grieve, 2014; Pedrosa-de-Jesus et al., 2014; Raupach et al., 2009), nor my own feelings of disappointment when I see that an interesting looking course is to be delivered online rather than face-to-face. I also explored economic theories of decision making that explain online task-switching as a rational, utility-optimising behaviour (Payne & Howes, 2013) but rejected these because they assume that the utility-optimising student has perfect knowledge of the educational value of their current and all alternative learning materials.

Other candidate theories included two widely used socio-material theories in education – Cultural Historical Activity Theory (CHAT) and Actor Network Theory. Engeström (2018) developed the well-known contemporary version of CHAT, which shows that the link between a person and their activity is mediated by tools and community. CHAT reduces the relationship between the variables to a triangle (or sometimes linked triangles) and while this approach is useful for focussing enquiry on relationships in a learning system and for organising data, it lacks explanatory power and is perhaps better seen as an organising framework. Clemmensen (2016) reviewed the use of CHAT in Human-Computer Interaction (HCI) research and concluded that frequently it required

modification or use in conjunction with other theories. Actor-Network Theory (ANT) is another theory often used in education when the concern is focused on interaction. It conceptualises education as composed of fluid networks of attitudes, values, artefacts, rules, and so on, with "human and non- human elements [linking] together to act" (Fenwick et al., 2011). One of the main conceptual difficulties with ANT is the proposal that human and non-human actors have symmetrical relationships, each having equal agency with respect to the other. The idea that technology helps to determine the way in which people learn is an important one in view of popular conceptions about the effect of the internet on attention span and critical thought (Carr, 2008) but, whether "technology" is considered as a single device or course, or as digital technology in general, it is difficult to see this phenomenon in the form of a symmetrical relationship between a learner and technology. Fenwick *et al*. (2011, p. 95) challenge ANT's status as a coherent theory, calling it a "virtual 'cloud', continually moving, shrinking and stretching, dissolving in any attempt to grasp it firmly" a view also held by Bruno Latour, the academic most closely associated with ANT, who describes it as "not a theory of the social…It is a theory of the space of fluids circulating in a non-modern situation" (Latour, 1999, p. 22). While ANT offers an orientation to complexity that is valuable, its lack of precision and clarity makes it less useful as a framework to guide enquiry.

It is difficult to plan a research programme using "clouds", organising frameworks that lack explanatory power, or explanations that do not resonate with your lived experience, and I feel fortunate to have discovered Tomkins' unjustifiably neglected work. However, the work of theorising does not end with the discovery of a good explanatory theory. There are also philosophical theories that need to be discussed and specified. These are

ontological and metaphysical (what sort of things there are and what they are like); epistemological (how we can know about them); and axiological (why we think they are important). In the next section, I will briefly outline ontological and metaphysical concerns, and discuss epistemic and axiological issues in the Methodology and Discussion chapters respectively.

Ontological and Metaphysical Theories.

An understanding of the nature of the entity we wish to study is necessary before anything can be said about its relationships. Nothing meaningful can be said about how to foster or inhibit learning engagement without an understanding about what sort of a thing learning engagement is (ontology) and what its properties are (metaphysics). Again, such philosophical questions are taken for granted in most health science research, but ontological advances were behind many of the medical milestones that contributed to the stable nature of contemporary medical research; for example, the ontological contribution made when the English physician Thomas Willis suggested in 1694 that the sweet urine in the “pissing evil” was due to a problem in the blood (too much sugar) rather than a disease of the kidneys (Karamanou et al., 2016).

It should be acknowledged that many of these medical ontological advances were possible because the object of interest were accessible to the investigators’ microscopes and animal models but, while these analytical approaches are not open usually to social scientists, “armchair” analyses, such as conceptual analysis, are available and may be underused. In his book “The Ant Trap” Brian Epstein argues that the failure of social

theories to predict important phenomena, such as global financial crashes, is a result of a failure of ontology – research programmes that are built on a "shaky understanding" of the questions "*What **are** social facts, social objects, and social phenomena?"* [emphasis in original] (Epstein, 2015 p7) and Epstein proposes a framework for a social ontology in which the grounding and anchoring of social facts must be examined. Scheel (2021) reported a growing recognition of this problem in Psychology, and argued that researchers should spend less time testing hypotheses and more time clarifying concepts and the relationships between them.

Similarly, a research question about learning engagement in digital environments needs to address the ontological question: what **is** learning engagement? And also the subsidiary questions: what sort of thing is it? What are its antecedents? What are its attributes? As to the type of thing it is, learning engagement can be considered a concept: that is, an object without spatial properties although it does have temporal properties. It can also be considered a real object, existing in the external world independently of my thoughts about it – as I write, students that I will never meet are, somewhere in the world, occupied in an activity that I would recognise as engaged learning. However, as D'Mello (2021) points out, while we recognise that there are behavioural , cognitive and emotional components to learning engagement there is no widely accepted definition; and, as to the antecedents and attributes of learning engagement, I suggest we also have a shaky understanding of these. Clarifying them would be a useful aim for enquiry and that is something that I will develop in the Discussion section of this thesis, using in the interim an informal understanding of learning engagement as the behavioural, cognitive and emotional characteristics of

students' interactions with learning materials (D'Mello, 2021). Establishing an ontological position on the nature of the learning mind would be a good starting point for defining learning engagement more precisely, and that is the subject of the next chapter.

3. An ontology of the learning mind

Later in this thesis, I will explore medical students' constructions of digital and non-digital learning. Several of their comments, but particularly one student's statement that "you miss the little things that make you human" when learning online, raised the question of what it *means* to be a learning human, and what those little things *are*. In this chapter, I establish an ontological position on the nature and attributes of the learning mind, rejecting Cartesian dualism, and accepting the arguments originally made by Aristotle but convincingly articulated by Alexander Bain that the mind is extended in the human body. This chapter draws on some older philosophical arguments that I will support and update, using some more recent work in neurophilosophy and neurophysiology. I argue for the importance of curiosity in learning and, reflecting on the evolution of the human mind, suggest that the learning mind can be seen as an embodied agent, roaming through and actively scanning the environment to determine what situations mean for its preferred outcomes. In this chapter, the human mind is presented at an ontologically fundamental level that could equally apply to other animals. A discussion of the higher intellectual powers of the human mind, particularly regarding motivation and behaviour, will follow in Chapter 4.

The Mind – Cartesian dualism or extension in space?

The question of how the world is perceived and how conceptions of the world can be formed in the mind has been problematic since Descartes drew the distinction between mind and matter. In the Cartesian view, the mind is what remains when the extended

world (matter and space) is subtracted from consciousness (Bain, 1868), but this duality leads to an apparently intractable problem about how thoughts in the internal world can result in actions in the external, extended world. This problem is dissolved by the alternative view, that the mind does have the property of extension because it inheres in the human body. In the embodied view, the mind is seen as an embodied agent moving through and actively scanning the environment, while integrating information that is exteroceptive (from the environment), proprioceptive (information about the position of muscles and joints) and interoceptive (awareness of the body's state and needs). The idea of the embodied mind has become popular in recent years (for example, Lakoff & Johnson, 1999) but its origin in Western philosophy can be traced back to Aristotle (Smit & Hacker, 2020).

The Scottish philosopher, Alexander Bain offers a detailed and comprehensive account of the embodiment of human feelings, volition and cognition, stating "I believe it to be a general law of the mind that, along with the fact of inward feeling or consciousness, there is a diffusive action or excitement over the bodily members" (Bain, 1864, p. 96). Bain gives many examples of the intellectual and emotional properties of muscular and organic feelings, for example the pleasure from movement offered by: "the rocking chair introduced by the Americans, who seem specially attentive to the luxuries of muscular sensibility." (Bain, 1868, p. 90), and the recognisable nature of many of his descriptions make his argument attractive.

The notion of the embodied mind, as described by Bain, also offers an explanation for human rapport. We understand emotions because we experience them ourselves. While

we do not have access to the consciousness of others, we can recognise and share feelings because we recognise the bodily expressions of emotion in others. Bain argues that there is an involuntary disposition to take on the feelings of others that is part of our human constitution (Bain, 1865, p. 172). That is why we experience a lifting of the heart when we see a lamb gambolling in a field or experience a pang of sadness when we see a person stooped and weeping in a hospital. Humans are not alone in this, dogs also read the embodied intentions and moods of other dogs and people, and they express their sympathy or responses in a bodily way.

Bain does not say much about sustained intellectual effort and concentration, regarding it as a learned moral habit (Bain, 1865, p. 472). However, regarding intellectual endeavour, Bain notes the motivating (Bain, 1865, p. 156) and sustaining (Bain, 1865, p. 99) power of curiosity, a concept that is worth exploring further.

Curiosity and Learning

The Shorter Oxford English Dictionary (1993) defines curiosity either as “a desire or inclination to know or learn about something", or as a property of objects that are rare or strange. Obsolete uses include reference to skill or ingenuity, or to “inquisitiveness about matters that do not concern one”. It is a concept that is of interest to people investigating artificial intelligence: transdisciplinary groups working in robotics-neuroscience-philosophy construct curiosity as an imperative actively to sample the environment in order to generate inferences about what a context means for an organism in terms of its preferred outcomes, and to resolve uncertainty (Linson et al., 2018). Curiosity has been

formally shown to be the basis for learning when using Bayesian models of thinking (Friston et al., 2017) and, by updating information about the environment, it clearly has a survival benefit for living creatures and should probably be considered a biological drive – a mechanism for ensuring survival and reproduction.

It is useful to distinguish between curiosity about concepts - epistemic or intellectual curiosity; and curiosity about the environment - perceptual or sensory curiosity (Berlyne, 1954). Intellectual curiosity is something that we assume is limited to humans, but perceptual curiosity is something shared with other living creatures and is also a design goal for roboticists. Intellectual curiosity has become a popular concept in recent years because, like “grit”, it has been identified as a predictor of success in both education (von Stumm et al., 2011) and the workplace, and therefore as a personal characteristic that can and should be cultivated. Despite a currently high volume of websites and popular articles promoting intellectual curiosity as a key to success, it seems to have escaped recent, serious conceptual analysis in the field of education. Intellectual curiosity is not limited to conventional learning environments, it may also be subliminal: the growing aesthetic cognitivism movement in the Arts (Graham, 2005) argues that engagement with Art is driven by curiosity rather than a mysterious phenomenological experience: the consumer gazing at a Jackson Pollock painting is not so much immersed in a feeling of awe, but is rather trying to understand what it means to him. Affect-laden curiosity also explains engagement with fiction and drama: in the best forms of imaginary narratives, we care about what happens next to fictional characters even when there may not be much to be said about a deeper meaning of the drama.

In contrast, perceptual curiosity and curiosity driven behaviour has been widely identified in the living world: even slime mould has been shown to “make decisions” about its direction of growth based on environmental sampling, and it makes more mistakes when required to respond more quickly (Trewavas & Baluška, 2011). Social cooperation emerges from this understanding of curiosity because it allows groups to leverage more information from an ecological niche (Linson et al., 2018), something exploited by amoebae when they hunt cooperatively (Trewavas & Baluška, 2011). The imperative to sample the environment and ask: “what is this and what does it mean for me?” is extended to our human “reading” of other people and subsequent decisions about how we should respond to them and the importance of the information they contribute. Curiosity about others: what they are thinking, how they are reacting – whether they are also finding a lecture opaque, for example – can be considered a special type of perceptual curiosity.

Perception: in two and three dimensions

An understanding of the nature of perception is necessary for understanding perceptual curiosity. For the embodied mind, perception is an active process that requires work. It was described by the Pragmatic philosopher CS Peirce (1891) as a process of creative abductive inference, and by James Gibson as: “an act, not a response, an act of attention, not a triggered impression, an achievement, not a reflex” (Gibson, 1979). For sighted people, visual perception is usually the pre-eminent way for collecting information about the world. Bain states:

> *"For the purposes of discriminating and identifying natural things, and also for the storing of the mind with knowledge and thought, the sensations of the objects of sight are available beyond any other class. The eye is kept constantly at work upon the surrounding scene, following the outlines and windings of form as these extend in every direction; and, by the movements thus stimulated, each separate object is distinguished" (Bain, 1864, pp. 238–239)*

In other words, Bain, Gibson and Peirce agree that visual perception consists of the *active* collection of information about relationships between three dimensional surfaces, and the process of making sense of them. These philosophical claims are supported by more recent work in the neurophysiology of perception, which has shown that we perceive our environment using saccades, rapid, conjugate scanning movements of the eyes that occur several times a second, and which provide information that is smoothed and interpreted by neuro-cognitive structures (Melcher & Colby, 2008). This active process directs gaze, as well as making sense of what we see, and it is how we have evolved to interact with our environment.

The ability to perceive and make sense of two dimensional images and representations is considerably more recent in evolutionary terms. There is some debate about how we see pictorial representations, for example, but there is evidence that the information we derive from two dimensional images is learned, culturally specific, and requires additional work to interpret pictorial symbols. Deregowski (1976) gives an interesting example, that I have reproduced below.

[Image removed for ORA copyright reasons]

Figure 3.1: A family group, taken from (Deregowski, 1976). Original drawing from “Simple Reading Material: its Preparation and Use” (Paris: UNESCO, 1963)

When the image in Figure 3.1 was shown to Westerners, it was usually interpreted as a family group indoors, including a young woman siting beneath an open window. However, when shown to East Africans, the young woman in the centre was often seen as carrying a four gallon tin on her head. As Deregowski points out, the African view can be readily appreciated by covering the rough shading that, by convention, represents the corner of the room and, once this has been done, it is difficult to see the picture without the tin can. This example also illustrates the realist view of perception: perception presents us with mind-independent items – such as the lines drawn in Figure 3.1 and the relationship between them, but the phenomenology of the perception depends on our mental processing (Beck, 2019). Curiosity is part of this mental processing, directing attention towards objects that might have meaning to the embodied mind – such as something “seen out of the corner of the eye”, and also causing the eye not to linger on objects determined not to be of interest.

The learning mind

Three intuitively appealing and empirically supported concepts can then be drawn on to propose a “working ontology” of the learning mind, which is:

1. Embodied. Integrating information from the senses directed to the external world, proprioception from muscles, and from awareness of the internal environment.

2. Actively perceiving and scanning the external environment, presenting mind-independent sense data to the mind for neurocognitive processing, and
3. Inherently curious. Curiosity about the environment has evolved as a property of the mind that has survival benefit for individuals, and the collective curiosities of groups can be harnessed for cooperative work.

The embodied mind can therefore be conceptualised as moving through three dimensional environments, actively scanning, and asking “what is this?” and “what does it mean for me?” in ways that seem to be shared by humans, amoebae and slime mould, and this is the type of learning that humans and other animals have used for survival for millennia. What is less clear is how this ontology of the mind applies to intellectual curiosity and academic learning, how it might contribute to an understanding of academic learning engagement, and how the two similar concepts of active perception and inherent curiosity are related.

These two issues will be re-visited and addressed later in this thesis. For the moment, and as a next step, it is useful to identify a compatible explanatory theory that could explain higher intellectual functions such as motivation to learn.

4. Explanatory theoretical framework

In Chapter 2, I argued that, as well as appealing to our subjective inclinations, a good theory should have explanatory power; it should be epistemically vulnerable; and it should be simple but capable of explaining a wide set of phenomena. Having established an ontology of the learning mind in Chapter 3, I now start to develop a framework to explain sustained attention. The motivating power of affective feeling states is central to the arguments I will develop, and I start by exploring the nature of affect before describing Silvan Tomkins' Affect and Script Theories. I show how Tomkins' theories meet the criteria for a good theory that were stated in the Chapter 2, and are therefore capable of generating new knowledge, and I derive a testable script theoretical hypothesis about digital learning engagement from them.

Although Tomkins' theories are epistemically vulnerable, it can be challenging to design empirical tests of them in practice. I then examine a second "good theory", George Kelly's Personal Construct Psychology. Like Tomkins' theory, Kelly's offers a coherent explanation of human thought but, in addition, it offers a logic of enquiry and a method. I make the epistemic argument for triangulating theories that show convergence and I triangulate Tomkins' theories with Kelly's. This offers extra metaphorical depth, but it also makes Kelly's logic of enquiry available for an empirical assessment of Tomkins' ideas.

A Spotlight on Affect

Affect is a term that, loosely speaking, refers to pleasant or unpleasant feeling states. Its more precise definition is contested because of a longstanding lack of agreement about the relationship between affect and the other feeling states - emotion, feelings and moods. William James (1884) has been accused of causing a century of confusion by mistaking "feeling" for "emotion" (for example, Scherer, 2005) when he described emotion as the subjective experience of internal physical changes, but more modern attempts to define emotion and affect have still not been able to create consensus definitions for feeling states (see for example, Loewenstein, 2005).

Although some authors consider emotions and moods as classes of affect (Niven, 2013; Scherer, 2005), in this thesis I have accepted the argument that affect should be considered the "psychologically primitive" (because irreducible) phenomenon (Barrett & Bliss-Moreau, 2009), and that affect is distinguished from moods and emotions because the latter have additional components, such as ideas. In the following work, I will use the term "affect" to signal these primitive, positive or negative feeling states, but use the term "emotion" when it is used by the primary authors I have drawn on.

In contrast to the other vital human systems – drives, cognition and the homeostatic systems – there is remarkably little consensus on what should be considered a primary affect (S. S. Tomkins, 2008h), and the lack of a consensus definition also means that there is little knowledge about the nature of affect. However, if the notion of the embodied mind is accepted, we can also accept James's characterisation of affects as the subjective experience of physiological changes: they *are* the first-person experiences of internal

sensations - the experience of the racing heart, the prickling skin, or more subtle internal sensations that do not reach conscious awareness (S. S. Tomkins, 2008i). Affective responses lend colour and flavour to human experience.

Early in my research for this thesis, I conducted a scoping review that was partly motivated by a wish to map the theoretical swamp I found myself in [see Appendix A]. One of the papers that caught my attention used video clips from reality television to teach emergency medicine, and it highlighted the importance of emotion in learning (Osborne et al., 2021). The search for an explanation about why and how emotion influences learning led me to the field of affective neuroscience, which I found compelling: supported by arguments from evolutionary biology and empirical evidence from functional magnetic resonance imaging, the argument goes that cognition and affect are intimately connected. We learn what is important to us; and what feels important is shaped by the emotions generated by the social and physical environment (Immordino-Yang, 2016). The identification of emotion as an important component of learning engagement also seemed particularly interesting, because it suggested that those trying to improve digital learning engagement might more productively target the affective response, rather than trying to create a sense of fun by incorporating game-based elements, or trying to engineer online social connections.

From contemporary affective neuroscience, I was led to the affect and script theories of Silvan Tomkins. Tomkins was a philosopher turned psychologist, who produced a comprehensive theory of personality between the 1950s and his death in 1991. His claims are supported by a wealth of empirical data (S. S. Tomkins, 2008a) and, as I will show

later, it is possible to derive falsifiable hypotheses from them and thereby generate new knowledge. These attributes, together with the opportunity they give to examine affective responses to learning make them very attractive theories to work with.

Tomkins on Affect

Tomkins' early work was a study of affect which, consistent with the embodied view of affect outlined above, he understood as a physiological response that generated sensory feedback that is "either inherently acceptable or unacceptable" (S. S. Tomkins, 2008g, p. 135), and which may or may not reach conscious awareness to be experienced as either pleasant of unpleasant (S. S. Tomkins, 2008i). Tomkins argues that affects are the primary motivating mechanisms (S. S. Tomkins, 2008i), in that we seek to maximise the experiences associated with positive affect and to minimise the experiences associated with negative affect. Affect is integrated with the drives and cognitive processes that give rise to thoughts and behaviours, and it gives them meaning by making us care about them.

Affects are innate and inherited, and Tomkins reports evidence indicating that individual differences in affective response are present at birth (S. S. Tomkins, 2008i). However, patterns of affective response and the expression of affect change over the life course – for example, initially frightening stimuli becoming less frightening with habituation (S. S. Tomkins, 2008i). An important characteristic of the affect system is that, in contrast to the drive system where one might be aware of early hunger or thirst, affects that are not particularly intense may not reach conscious awareness; affects may also be supressed if

their unacceptability has been learned, for example fear in a military context. These factors reduce the visibility of affect, making self-report unreliable (S. S. Tomkins, 2008i) and contributing to the challenges of assessing affective response, something that will be discussed in more depth in the Methodology chapter.

However, while Tomkins (2008h) acknowledges the visceral contributions to affect, he argues that the face is a primary site of affect – it not only communicates affect to others, but we *feel* affect mostly as a result of changes in the skin and muscles of the face. The strangeness of this idea may have contributed to Tomkins' obscurity, but his success in predicting the behaviour of race-horses (Brewster Smith, 1995) and some cultural aspects of pre-literate tribes (Ekman, 1995) based on facial expression alone, lends weight to this claim and the use of facial expression to determine affect has now been codified (Ekman & Rosenberg, 2005) and has become a fairly mainstream approach in psychology even though there is little evidence to support the practice (Barrett et al., 2019).

Tomkins recognised nine primary affects, based on characteristic facial responses. The four negative affects are: Distress-Anguish; Anger-Rage; Fear-Terror and Shame; the latter having received much attention because of its importance in identity and self-esteem. The two positive affects are Enjoyment-Joy and Interest-Excitement. Lastly, there is the "resetting affect" of Surprise-Startle; and two auxiliary affects: Disgust and Dissmell, which are experiences of aversion to people, things and ideas. The affect interest-excitement is particularly relevant to understanding motivation to learn, and it will be considered in some detail next.

Affect and sustained intellectual work

One of Tomkins' two positive primary affects is interest-excitement, which he characterises by the facial expression of "eyebrows down, track, look, listen" and which has, he states, been "most seriously neglected" (S. S. Tomkins, 2008e). It is barely mentioned in Charles Darwin's account of the expression of emotion (Darwin, 1904), nor in more modern treatments of emotion such as Martha Nussbaum's (Nussbaum, 2001b). Interest-excitement may be less dramatic than fear, rage or joy, but it is the affect that directs attention to exciting or interesting objects. Paying attention is something that we take for granted but, as Nathanson states, "the sheer ordinariness of this affect has precluded serious investigation for centuries." (Nathanson, 2008, p. xviii). Both interest-excitement and surprise-startle are orientation affects in that they combine with other stimuli to direct attention, but it is interest-excitement that gives the capacity for sustained attention to an object (S. S. Tomkins, 2008e) and it is therefore interest-excitement that is the key affect for determining sustained attention to learning materials and learning engagement. As Tomkins says:

> *"There is no human competence which can be achieved in the absence of a sustaining interest, and the development of cognitive competence is peculiarly vulnerable to anomie"* (S. S. Tomkins, 2008e, p. 188).

Interest-excitement: implications for digital environments?

Using Freud as a case history, Tomkins suggests that for sustained, creative intellectual effort, an individual needs to have an exaggerated intensity of interest-excitement that is directed towards ideas and intellectual activity, together with a tolerance for the negative

affects that inevitably appear at some point during long term effort. The mastery of these negative affects in education is, he states, grossly neglected (S. S. Tomkins, 2008e). Tomkins' analysis of the conditions necessary for interest-excitement seems highly relevant to an analysis of learning behaviours in the easily accessed riches of the digital environment.

Firstly, he argues that uncertainty and novelty are necessary for interest-excitement:

> *"When [a] performance is governed perfectly by analogs, constructed, deposited and learned how to be retrieved from memory, and environmental variation is successfully anticipated, then excitement declines, and the activity can be initiated and monitored with a minimum of both excitement and consciousness…The quest for the novel loses its appeal when the individual is satisfied with and enjoys the world as it is. An enduring discontent or at least the absence of complete seduction by the familiar is a necessary condition for the pursuit of the novel"* (S. S. Tomkins, 2008e, p. 194)

He also suggests that in predictable environments, where people are seduced by the familiar and in which the "quest for the novel" may be as undemanding as a Google search, interest-excitement will decline. This resonates with other arguments that too much choice has negative consequences, leading to decision regret, choice switching and prevarication (Chernev et al., 2015; Jessup et al., 2009; Reed et al., 2011; Schwartz, 2004). Perhaps then, the overwhelming amount of information of the internet, and the ease with which it may be accessed, might lead to a reduction in interest-excitement when learning online. Tomkins' ideas about interest-excitement being necessary for sustained attention, but also decaying when there is "complete seduction by the familiar", seem a

promising starting point for examining digital learning engagement. Further structure of this idea is provided by his script theory.

Script Theories: in General and in relation to Tomkins' work

Tomkins' earlier work on affect evolved over several decades to become a comprehensive theory of personality (R. Carlson, 1995), in which he explains human conscious experience in terms of the recognition of affect-laden scenes and their scripted responses. However, Tomkins is not the only author to suggest that humans use pattern recognition to "fill in the gaps" and infer meanings from situations where they have incomplete information. Piaget is generally credited with the first description of scene recognition as a component of thought, distinguishing between rational and "schematic" thought, in which:

> *"(t)he mind leaps from premise to conclusion at a single bound, without stopping on the way…The vision of the whole brings about a state of belief and a feeling of security far more rapidly than if each step in the argument were made explicit….Personal schemas of analogy are made use of, likewise memories of earlier reasoning, which control the present course of reasoning without openly manifesting their influence"* (Piaget, 1932, p. 47).

Several authors use the term "script" to describe patterned behaviour. For example, Eric Berne uses the term "scripts" in his Freudian Transactional Analysis (Berne, 2015) to describe unconscious life plans that are formed in infancy, something that Silvan Tomkins (S. Tomkins, 1995) refers to as "unauthentic 'games'". Other authors frequently cited in connection with script theories are Schank and Abelson (1977), who describe how scripts serve an important function by allowing us to interpret experience and behave appropriately when possessing incomplete information. When we recognise a script, we

are able to infer the missing information. In Abelson's (1981) restaurant example, if we hear that John enters a restaurant and is concerned to find, as the waiter approaches, that he has left his glasses at home, we can infer that John is worried about not being able to read the menu. This is because we understand the "restaurant script" and can fill in the missing information because we know what happens next when waiters approach a diner's table. The Schank and Abelson version of script theory suggests people interpret new situations and make decisions about action by matching current experience to patterns of past experience; it has informed artificial intelligence, marketing theory (Leigh & McGraw, 1989) and has been often cited to explain clinical decision making (Schmidt et al., 1990).

However, Schank and Abelson's view of script theory is purely cognitive. They use the computer as a metaphor, arguing that if a theory of human thought cannot be tested by a computer, there is no way of knowing if it is right (Schank & Abelson, 1977). The cognitive version of script theory is a convincing explanation about how doctors learn to solve clinical problems but is an inadequate explanation for thought processes that are not recognisably cognitive and rational. Tomkins' version of script theory goes beyond explanations about knowledge storage and retrieval. It acknowledges that humans "think" in a way that computers do not and integrates ideas about human cognition, drives and affect to provide an elegant and consilient explanation both of individual personality and motivation, and of inter-subjective ideologies. It therefore offers an appropriate framework for examining why students just "don't like" asynchronous online learning even when it is considerably more convenient, or prefer reading from paper when no cognitive advantage for paper can be identified (Kretzschmar et al., 2013).

Tomkins' Script Theory

In Tomkins' version of script theory, the theatre is used as a metaphor. The narrative of a life is played out in a series of scenes, where each scene consists of at least one affect and the object of the affect. When using Tomkins' script theory, scenes and their scripted responses become the units of analysis for those investigating the thoughts and behaviours of humans (R. Carlson, 1982), where scenes are described by their salient features and grouped into families of connected scenes, and scripts are the rules for responding to families of scenes.

The importance of a scene experienced In a person's life depends on two sorts of magnification. Firstly, **affective magnification** gives an experience meaning by virtue of the affect attached to it, and the greater the intensity of the affect, the more salience an experience has. A second type of magnification is **psychological magnification**. This refers to the extent to which scenes and scripts connect with each other to determine the narrative of a person's life. Personal scenes and scripts can be considered in four broad categories according to their degree of psychological magnification:

Transient scenes: are not related to other scenes and do not result in important scripts. An example might be an experience such as watching a movie: even if intense affective magnification is experienced, the effect is usually transient and there are rarely implications for an ongoing life.

Nuclear scripts: Are those that set the agenda for a large part of a person's life because they are psychologically highly magnified. An important scene becomes linked to others

that are similar enough, and which become endowed with the interpretation of and affective response to the initial scene. A family of scenes that result in a scripted, emotionally laden response is created. The script determines how related scenes are interpreted and experienced, and this can become self-reinforcing: the script eventually determines the scene. Tomkins calls these types of scripts “nuclear” because of their self-propagating nature and gives an example of a person who is constantly humiliated, who looks for insincerity and hidden criticism in a compliment (S. S. Tomkins, 2008f). Tomkins suggests that nuclear scenes are typically initiated by a good scene turned bad, for example an experience of rejection that colours attitudes to future relationships, but Carlson (1982) also describes “good” nuclear scripts where altruism becomes the defining agenda of a person’s life.

Habitual scenes and scripts: are those that have become routine and are rarely thought about. An example given by Carlson (1982) is the habitual altruism of a caring health professional. These scripts may have been magnified at some point, but are no longer because they are subject to decay, for example burnout. The processes and behaviours associated with most digital interactions in higher education could be considered as following habitual scripts because behaviours such as browsing, downloading web pages and using interactive tools are very routine activities for most students. While students may reflect on the content they consume, it seems unlikely that they reflect deeply on their webpage navigation and choice switching behaviours.

Intermediate scenes and scripts: are neither trivial, like habitual scripts, nor profound, like nuclear scripts and fall somewhere between these two.

Applying Tomkins' script theory to online learning engagement

As indicated earlier, Tomkins argues that affect is the primary motivating mechanism: affect makes things important to us by making us care about them, and the affect of interest-excitement is necessary for sustained attention. While the influence on learning of affective response to educational content has been investigated in medical students (Artino et al., 2012; Osborne et al., 2021), less attention has been paid to the affective response to the learning medium–- specifically, to the online space. The question of whether the digital environment itself produces affect-laden, scripted responses that influence learning engagement is an open one.

Tomkins' work can be considered "grand theory" because it offers a comprehensive account of human thinking (Brewster Smith, 1995). I argued in Chapter 2, that a useful theory in empirical enquiry needed to be close enough to the data to generate testable, working hypotheses and Tomkins' Script and Affect theories are at too high a level to do this. However, it is possible to derive a middle-range theory about digital learning engagement from them. Given the lack of engagement with asynchronous learning reported in both the scoping review and the design research project that are described in the Introduction, the possible negative affective reactions associated with choice overload (Chernev et al., 2015; Fasolo et al., 2007; Jessup et al., 2009; Reed et al., 2011), and Tomkins' analysis of the conditions required for sustained attention, the following middle-range, script theoretical hypothesis about screen-based, digital learning engagement can be proposed:

Online learning tends to activate scripts of superficial engagement and facile termination of activities, that have been fostered by other online activities (in a context of choice overload).

Tomkins' work is now largely neglected. Just 10 years after Tomkins' death, Nussbaum (2001b) provided an account of emotion in which she argued that emotions are "evaluative appraisals", influenced by past experience, that shape the landscape of our thoughts and thereby give them meaning. However, her arguments are based on Stoic philosophy and Tomkins does not get a mention – he seems already to have slid into obscurity. One reason for this is that, as Brewster Smith (1995) states, he was a better theoretician than he was a communicator. He tended to write for obscure journals (Demos, 1995a) and the first two volumes of his defining work Affect Imagery Consciousness appeared in 1962 and 1963, with a bibliography delayed until volumes 3 and 4, which were published in 1991 and 1992 respectively (Brewster Smith, 1995). Philanthropic support was required for the publication of an affordable complete edition in 2008, 17 years after Tomkins' death (Nathanson, 2008).

Affect Imagery Consciousness is densely written and it is fortunate that Virginia Demos (Demos, 1995b) has compiled a selection of his works with introductory material by Tomkins scholars, although the contributors' optimism that this volume would give Tomkins' ideas appropriate recognition (R. Carlson, 1995) was misplaced. An additional factor that may have contributed to this obscurity is that, while he gives us a richly imaginative framework for understanding human thought and action, he leaves us no logic of enquiry and no method other than facial affect scoring, a method that will be

critiqued in the methodology chapter. To plan an empirical enquiry of the script theoretical hypothesis I have proposed, it is useful to look outside Tomkins' work and to explore a tool developed by another theorist.

George Kelly's Repertory Test

Of the methods that I explored when planning my empirical work, one stood out: the repertory grid test, described in George Kelly's seminal work on Personal Construct Psychology (Kelly, 1955). This was because Kelly's grid offers a method for determining whether different things are thought about in similar ways, an important asset when trying to determine whether online learning behaviours are fostered by other online behaviours, such as the use of social media. Kelly explains human thought and personality in terms of a system of "constructs", which are hierarchically linked dimensions of appraisal that we apply to our experience in order to make sense of it. In Chapter 5 of "The Psychology of Personal Constructs", Kelly offers a method for eliciting a person's construct system, in which a person is asked to make discriminations between different elements suggested by the interviewer. The set of bipolar dimensions of appraisal volunteered by the person are accepted as the verbal representations of his or her construct system, and the person is then asked on what pole of the construct different elements should be placed. The idea is to examine how people "construct" situations or relationships and to probe beneath the words a person uses to describe them. Elements can also be scored against the different poles of the construct and it is possible to plot the scoring patterns to see which elements are "psychologically similar" to each other and in what ways. The repertory grid will be explained further, and illustrated with an example, in the next chapter.

Over the past six decades, Kelly's original repertory grid test has been expanded into an extensive suite of repertory grid techniques (Fransella et al., 2004a) that are used in a therapeutic setting by Personal Construct psychologists and also used as research tools in diverse fields. For example, Wheatley (2020) used a visually adapted version of the grid to explore the relational worlds of people convicted of stalking, arguing that because the interpretation of responses to a grid interview are not obvious to the participant, the interview is less susceptible to "socially desirable responding". Atieno (2023) used the grid to produce a hierarchical value map of seed potato preferences in Kenyan farmers, leveraging the grid interview's capacity to identify connections and preferences, and allowing participants to use their own words to describe characteristics important to them. Grids have also been used to explore preferences in the food and hospitality sector (Chang & Mak, 2018; Mak et al., 2013), and marketing – for example, Kawaf and Istanbulluoglu's (2019) work on online fashion shopping-- because they allow researchers to probe individuals' experiences and preferences in a structured way.

There is a story, possibly apocryphal, that when asked what he would change about his Personal Construct Theory, Kelly in later life said that he would leave out the repertory grid[3]. If the story is true, the comment was probably not a serious one and was made in reaction to the atheoretical use of grids in, for example, market research. Using the grid as a tool to test a hypothesis derived from Tomkins' theory could therefore be seen

[3] This anecdote was reported in conversation between two authorities on personal construct psychology on YouTube (https://www.youtube.com/watch?v=z3uS7UA0P9M). I was unable to find an original attribution and Kelly's biographer Franz Epting had also not heard of it (personal communication). However, it does sound like the sort of thing he would say: Lester (2009 p90) reports that Kelly "liked to test people, to play games."

either as adding insult to injury, or as a legitimate extension of their use that does justice to Kelly's ideas. This dilemma can be addressed by comparing Kelly and Tomkins' theories, after establishing an epistemic justification for mixing theories.

Theoretical triangulation: the realist epistemology

Mixing theories is an established endeavour in science; for example, Papineau (1995) gives the nineteenth century example of the unification of the kinetic and atomic theories of gases. However, there is an epistemological implication of mixing theories that needs to be made explicit: mixing explanations about unobservable events only makes sense from a realist perspective, in which theories may converge to contribute to knowledge about an objective external reality. The alternative epistemic viewpoint, instrumentalism, holds that we cannot make "firm judgements about imperceptible mechanisms" (Papineau, 1995, p. 148) , and sees theories as convenient instruments for explaining the unseen rather than explanations of an invisible reality. If an instrumental position is taken, there is no "reason why a bunch of instruments should be unifiable into one big 'instrument of everything'" (Papineau, 1995, p. 149) and mixing theories therefore makes no sense.

An important realist perspective was offered by CS Peirce. He argued that we experience the world as "signs", which are perceptions of "real things, whose character is entirely independent of our opinions about them" (Peirce, 1982b). However, an agreed opinion about the nature of the object can be formed when it is investigated from different perspectives and the results converge (Peirce, 1982a). Peirce describes abduction, a form of reasoning common in scientific enquiry that resembles a deductive argument, but in

which the premises support rather than guarantee the conclusion. A hypothesis about a "real thing" is concluded to be true to the extent that is supported by verified predictions of premises and our confidence in this truth is progressively strengthened when it is supported by increasing instances of verification from different premises (Peirce, 1994).

The anthropologist-philosopher Gregory Bateson offered a slightly different view of realist abduction (Bateson, 1979). Using stereoscopic vision as a metaphor, he argued that combining information from more than one perspective generates more knowledge about something than does the sum of their contributions because "in principle, extra 'depth' in some metaphoric sense is to be expected whenever the information for the two descriptions is differently collected or differently coded." (Bateson, 1979, p. 70). Although Bateson does not describe how inputs should be selected to provide this extra dimension, Hui (2008) argues that similarity of premises is necessary. A description of the similarities and differences between Tomkins' Script Theory and Kelly's Personal Construct Psychology is required to establish their compatibility and indicate whether they can be combined in a way that adds depth of knowledge.

Similarities between Tomkins and Kelly

Both Kelly and Tomkins' theories can be seen as reactions to psychoanalytic theory and behaviourism, which were dominant at the time: they both objected, on the one hand, to the idea of a person as the passive dupe of subconscious psychological processes, and on the other to the human mind as a "black box" the contents of which didn't matter, only the behaviour that is generated in response to a stimulus. Both had an interest in the structure of thought. For Kelly, thought consisted of a "construing system" while for Tomkins, a

person's thoughts were constituted by a "minding system", but these systems are not incompatible. Kelly's postulate that "A person's processes are psychologically channelized by the ways in which he anticipates events" (Fransella et al., 2004b, p. 83) is compatible with Tomkins' view of scripted responses to familiar situations; while Kelly's view of a person's construct system as a way of processing events that are related by "complex patterns[s] of likenesses and relevant differences" (Fransella et al., 2004a, p. 6), is analogous to Tomkins' psychological magnification (or connection) of scripts. Finally, Kelly also uses the idea of theatre in his work, asking people to write "character sketches" of themselves in the third person, "just as if [they] were the principal character in a play"(Fransella et al., 2004a, p. 31).

Points of difference between Tomkins and Kelly

The treatment of affect is probably the main point of contrast between Script and Personal Construct Theories. As described earlier, affect is for Tomkins the primary motivating mechanism, because it determines how much and in what ways we care about things, but Kelly makes the slightly puzzling statement that his theory has "no *ego*, no *emotion*, no *motivation*, no *reinforcement*, no *drive*, no *unconscious*, no *need*." (Kelly, 1955). While several of these negatives clearly express rejection of psychoanalysis and behaviourism, the apparent dismissal of emotion as an important component of thought has troubled Personal Construct psychologists and led some to suspect that the comment was made "tongue in cheek" (Lester, 2009). Mildred McCoy (1977) has given the problem thoughtful treatment. She suggests that Kelly was rejecting the classical trichotomy of intellect, will and cognition, and was producing a more abstracted and therefore more integrated model of human thinking that was based on one system: the construal system. Although Kelly acknowledged the existence of some basic emotions, these were

explained in terms of felt experiences resulting from threats to or, alternatively, validation of, the person's construct system, an idea that McCoy expanded to a wider range of emotions (McCoy, 1977). This treatment of affect feels almost like an afterthought and it is not clear why, for example, events that challenge a person's construct system should be experienced as threatening rather than interesting, nor what purpose these feelings serve. Tomkins' view of affect as a basic system that infuses thought and gives meaning to thoughts and urgency to action makes more intuitive sense. Jerome Bruner reviewed Kelly's two volume work in 1956 and concluded:

> *"These excellent, original, and infuriatingly prolix two volumes easily nominate themselves for the distinction of being the single greatest contribution of the past decade to the theory of personality functioning… It succeeds in providing a diagnostic device strikingly in keeping with its presuppositions [but] fails signally in dealing convincingly with the human passions."* (Bruner, 1956, p. 355).

It seems unlikely that Kelly wished to reject the idea of emotion in human thought and it is a mistake to think of the construct system as a purely cognitive system. It is possible, for example, to conceive of predominantly affective constructs, such as a dimension of *exciting-tedious* against which learning media could be appraised and this indicates that affect must be an integral part of the construct system. In fact, when Constructivist psychologists focus on emotion, their model seems ever closer to Tomkins:

> *"Emotional memories of lived emotional experience are seen as being formed into emotion schemes. By means of these internal organizations or neural programs people react automatically from their emotion systems not only to inherited cues, such as looming shadows or comforting touch, but also to cues that they had learned were dangerous, such as fear of on''s fathe''s impatient voice, or life enhancing, such as a beloved symphony, and these reactions are rapid and*

without thought. Emotion schemes are organized response- and experience-producing units stored in memory networks". (Greenberg, 2010)

Using a combination of Tomkins and Kelly therefore seems a promising strategy for generating additional depth when trying to assess how students "really feel" about online learning. Tomkins suggests scripted, affect-laden responses as an elegant and appealing explanation of motivation and learning engagement, while Kelly offers a theory of the structure of thought that gives us a logic of enquiry and a method designed to uncover the thoughts beneath the words. Tomkins' and Kelly's theories are compared and contrasted in Table 4.1

Attribute	**Tomkins**	**Kelly**
Structure of thought	Theatre as the metaphor: people recognise and react to scenes	People see the world through patterns of constructs
Basic unit of analysis	Affect-laden scenes	The construct: a dimension of appraisal
Past experience provides current meaning	Explained by "psychological magnification" – the connection of affect-laden scenes	Explained by the construct system "psychologically channelising" events
Affect	The central motivating mechanism	"..no emotion, no motivation.." (?)
Methodology	Not well defined	The repertory test

Table 4.1 Tomkins' Script Theory and Kelly's Personal Construct Theory compared.

5. Methodology

In this chapter, I review the middle-range script theoretical explanation of superficial engagement with online learning that was proposed in the previous chapter, and derive some testable hypotheses from it. I examine the options for testing hypotheses that:

(i) students see online learning and general online use as belonging to a similar class of situations; and

(ii) that they experience different affective responses to digital and face-to-face learning media.

I conclude that the repertory grid is a suitable tool for testing both sets of working hypotheses. After presenting an example of a single grid, I frame the repertory grid as a mixed-method approach, building on the epistemic considerations introduced in Chapter 2, and paying particular attention to two important methodological issues – the strategies for combining data types in a way that produces value beyond the sum of their parts, and the difficult question about how to combine the data in multiple grids to draw conclusions about the shared construing of groups, without discarding much of the grid data. I then examine some other methodological choices that must be made when repertory grids are used, before finally, discussing ethical considerations for the proposed research. This chapter will focus on a critique of the available methods, and epistemic positioning. The methods eventually chosen for the empirical work are detailed in Chapter 6, which follows.

Deriving testable hypotheses from Tomkins' Script Theory

Planning an empirical investigation using Tomkins' script theory is challenging. Although his ideas were admired by those who had the privilege of discussing them with him, those scholars are academics of a previous generation and there are few of them left. Current Tomkins scholars are thin on the ground and tend to use his theories as explanations for various human phenomena, rather than testing them. Although Tomkins' theories have been used as explanatory frameworks for such diverse phenomena as machismo (Mosher & Tomkins, 1988) and the emotional patterns of classical literature (Lucas, 2018), and as a framework for psychotherapy (Tomkins Institute, 2022), moving from an appreciation of Tomkins work to formulating an empirical enquiry is a large step because there is so little work to use as a blueprint. However, the late Rae Carlson did publish a handful of papers (L. Carlson & Carlson, 1984; R. Carlson, 1981, 1982; R. Carlson & Brincka, 1987) that offer a useful guide, in particular her 1982 exploration of the altruistic personality which used the following steps:

1. Deriving testable hypotheses from script theory
2. Setting out expectations and then looking for confirmatory/disconfirmatory evidence

In the previous section, the following middle-range script theoretic hypothesis was derived:

Overall hypothesis:

Online learning tends to activate scripts of superficial engagement and facile termination of activities, that have been fostered by other online activities (in a context of choice overload).

Drawing on Carlson's (1982) model, some testable hypotheses that are even closer to the data can be derived from this:

Testable hypotheses:

1. There is a family of *related scenes* that determine engagement with educational *and* non-educational materials encountered in the online environment. In other words:
    a. Digital educational and digital non-educational materials are seen as representing a similar class of situations and
    b. They activate similar feelings and behaviours
2. Face-to-face learning has a higher ratio of positive to negative affects than does online learning
3. There is a differential magnification of excitement-interest between online and face-to-face learning activities

The methodological options for each of the testable hypotheses will now be considered in turn.

Looking for families of related scenes

Carlson addresses the issue of families of scenes in two reports. In the first, a single case history (R. Carlson, 1981), she offers an in depth case study of a single person, showing that a childhood scene of rejection became magnified by connection with other scenes of perceived rejection, so that a feeling of not belonging became a defining feature of the person's psyche. In the second (R. Carlson, 1982), a study of the altruistic personality using a secondary analysis of multiple case histories, she looks back into the life history of a person, as recorded in a case history, to identify families of related altruistic scenes. In both cases, Carlson is examining nuclear scripts, which are the defining narratives of a life. Searching for families of habitual scenes and scripts presents more of a challenge because they are, by definition, less salient. The crucial question here is whether general internet use and online learning are similar enough to represent a class of situations, in terms of how they are perceived by a learner and the behaviours they generate. A method capable of eliciting connected meanings that have not yet been explicitly considered by a participant is required.

Kelly's repertory grid offers a way to do this. A grid takes the form of a table that lists items of interest (called elements) on one axis, and the dimensions by which the items are appraised (constructs) on the other. Constructs can be elicited by a number of methods, but Kelly's original method was one of triadic elicitation, in which individuals are asked to compare groups of three elements and identify how any two are the same and different from the third, and this probably remains the most commonly used approach (Fransella et al., 2004c). Having identified the distinguishing characteristic, a participant is then asked for its opposite, thereby identifying two poles of a dimension of

appraisal. The elements, usually listed on the vertical axis, are then scored against the constructs, which are usually listed on the horizontal axis with one pole representing the bottom of the scoring range and the other pole representing the top of the scoring range.

The repertory grid in practice: an example

Table 5.1 shows a repertory grid from a fictional interview designed to elicit a junior doctor's constructions of professional behaviour in the workplace. The elements are shown on the top and map out a range of professional colleagues, perhaps including a liked colleague, a disliked colleague, a person in authority and a role model. Seven constructs have been identified by asking the participant to compare three colleagues at a time, to identify discriminating characteristics by asking the participant to identify any way in which two of the selected colleagues are similar to each other and thereby different from the third, and also the opposite of the discriminating characteristic. The characteristic and its opposite become poles of a construct. For each construct, one pole is assigned a value of 1 and the opposite a value of 5 (the direction is not important). The participant has then been asked to score all the elements – the colleagues and him/herself against the constructs.

1	Tracy	Alan	The Boss	Matron	Corinne	Desmond	Me	Ideal me	5
Listens	4	1	3	5	1	3	4	1	Thinks he/she knows best
Trains on the job	3	5	2	2	3	3	1	1	Doesn't take the time to train
Cuts corners	5	5	5	5	5	3	4	5	Thorough
"Wings" it	1	3	4	4	4	2	4	5	Knowledgeable
Well organised	4	1	3	1	1	4	4	1	Chaotic
Unpleasant	2	5	5	2	5	3	3	5	Nice to be around
Patient	3	3	2	3	1	3	4	1	Impatient

Table 5.1 A fictional repertory grid showing how elements are rated against constructs.

Asking participants to identify similarities and differences means that they have to search for their own meanings about elements and how they distinguish between them. This means that repertory grids offer a potential method for looking "under the surface" of habitual activities and making tacit knowledge, attitudes and beliefs explicit.

In addition, the patterns of scoring in the grid can be analysed. This is useful because elements that are similarly constructed will have similar scoring patterns and can therefore be considered psychologically similar (Fransella et al., 2004d). Many relationships could be assessed in a data matrix such as Table 5.1 – it would be possible to measure correlations between elements; between constructs; and between elements and constructs but it would be difficult to know what to do with the resulting data, given the large number of potential relationships. The most useful way of looking for patterns

in a data matrix like this is to use a dimension reduction technique, in which relationships are summarised by identifying dimensions that explain most of the variance in the data. A commonly used spatial representation of the relationships in a repertory grid is the biplot, in which clustering or separation of elements is graphed onto the X and Y axes of the first two dimensions (the two that explain most of the variance in the data), with the constructs that have generated these patterns shown on the same plot.

A biplot of the “toy” data in Table 5.1 is shown in Figure 5.1. In this example, the x axis is the first dimension and it represents 55% of the variation in the data. The Y axis is the second dimension, and it represents 23% of the variation in the data. Elements are clustered or spaced according to similarities or differences in scoring. The constructs that generated the scoring patterns are superimposed on the plot. In this plot, the participant constructs himself similarly to Matron and, while being knowledgeable and providing training, his ideal professional behaviour is in a different part of the graph where Corinne is modelling some different professional behaviours. The visualisation of clustering based on scoring similarities makes the biplot a suitable tool for looking for evidence of similar constructions of digital learning and general online use, in terms of engagement with the medium.

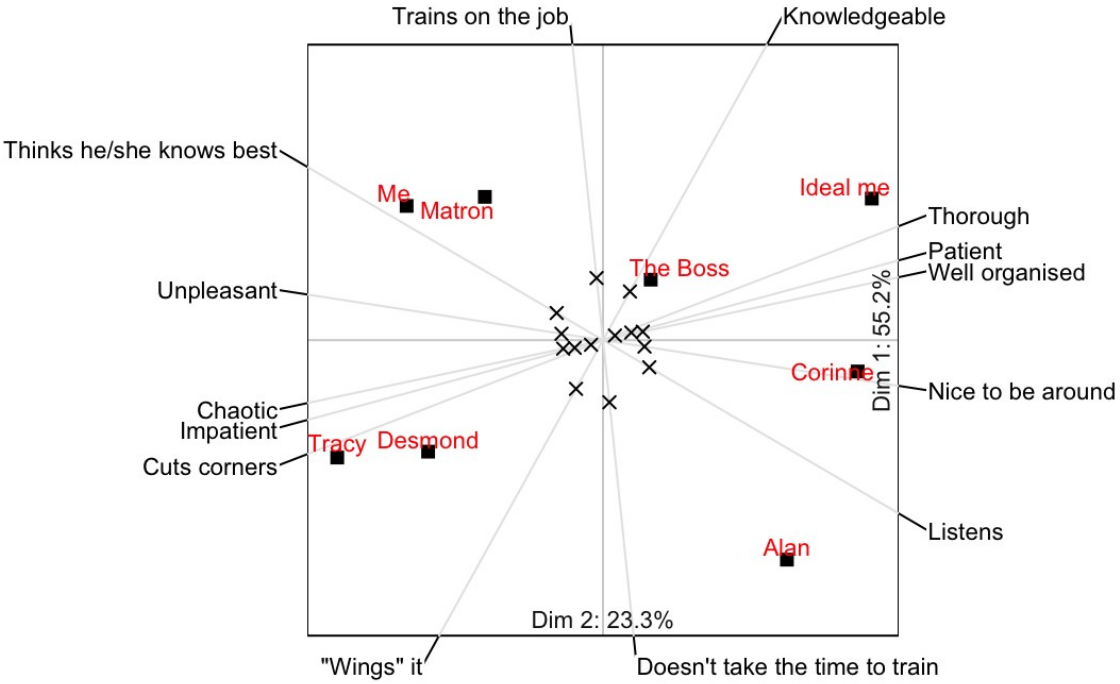

Figure 5.1. A biplot showing data from a fictional grid interview about professional clinical behaviours.

Looking for different ratios of positive to negative affect and differential magnification of excitement-interest

Asking people about their feelings is the most obvious way to measure affect, but it may not be the most reliable. People may be unwilling to declare their emotional state, or find it difficult to articulate beyond stating a valency (positive or negative) and intensity (Mauss & Robinson, 2009). In addition, an affective state may not reach conscious awareness (Barrett et al., 2019; S. Tomkins, 2008).

Facial Affect Scoring Systems have been validated and are well established (Ekman et al., 1971; Ekman & Rosenberg, 2005), but their use is challenged. A particular problem is that

they are based on prototypes of expressions that are simulated and stereotyped, and they are less reliable for scoring the more subtle, spontaneous emotions found in naturalistic settings (Dupré, Krumhuber, et al., 2020). The validity of results obtained from current digital affect scoring software is particularly questionable (ibid). A recent comprehensive review of facial affect scoring (Barrett et al., 2019) concluded that, while there may be a statistically significant association between particular facial expressions and discreet emotions, their predictive value is low. An additional problem is that current facial affect scoring systems do not distinguish between Tomkins' two primary positive affects, joy and interest-excitement, these both being subsumed in the single category of "happiness". Despite Tomkins' enthusiasm for using facial expression to assess affect, current evidence suggests that facial affect scoring is unreliable, and that it is necessary to look for alternative tools.

Physiological measures are another option. The stress hormone cortisol has been used as a marker for affective states in the past, but there is no consistent relationship between valency of affect and cortisol level (Buchanan et al., 1999). Alternative approaches use physiological measures, such as heart rate, breathing rate and sweating. Wearable technology that records and analyses these physiological rhythms is well established in sports science and professional sports, but has more recently been used to assess emotional response to activity, for example using a zip-wire activity that was expected to elicit an intense affective response with minimal physical exertion (Dupré, Andelic, et al., 2020). Patterned physiological responses in keeping with the predicted emotional state were found, although the authors note several limitations of the study, including artefacts from zipwire motion, and currently it is thought that this technology is able only

to determine intensity and valency of affect (Dupre, 2021). It is not clear whether this line of research will be profitable: in the 1960s and 1970s, a similar programme of research by behavioural psychologists also failed to identify physiological changes that reliably mapped on to distinct emotional states (Nussbaum, 2001a).

As noted earlier, repertory grids are well suited to identifying families of scenes, but can they also be used to assess affective response? Despite Kelly's statement that Personal Construct Psychology has "no emotion" (Kelly, 1955) it is quite easy to imagine constructs that have an emotional content, such as satisfying *vs* frustrating, or exciting *vs* dull. Even if affective constructs are not initially volunteered by participants, there are formal structured methods within grid technique that allow the researcher to probe for subordinate or superordinate constructs, such as the "laddering" technique described by Hinkle whereby participants are asked to identify the preferred pole of their volunteered construct and then to give the reason for their preference (Hinkle, 1965). Although grids may not be the most obvious choice for assessing the affective response to learning media, it is certainly possible that participants will volunteer affect-laden constructs or discuss affective responses during the grid interview. The repertory grid interview is therefore worth exploring as a method for assessing the affective nature of responses to learning, as well as the relationships between students' constructions of different learning modalities.

Using the grid as a normothetic research tool

Kelly's Personal Construct Psychology (PCP) explains the thought patterns of individuals, rather than the shared thinking of groups, and the example shown in Figure 5.1 is easily

understood as a representation on an individual's thought on a topic. But can his repertory grid be legitimately used in normothetic research to investigate the shared experiences of groups and produce transferrable findings? Kelly was not averse to the idea of using PCP to make inferences about constructs shared by groups of people, and the idea of shared construing is permitted by his Commonality Corollary which states that "to the extent that one person employs a construction of experience which is similar to that employed by another, his processes are psychologically similar to those of the other person" (Fransella et al., 2004e, p. 10). PCP has been used to examine, for example, how members of different political parties differently construct ideas about nationality (Fransella et al., 2004e). However, while combining grids is permitted in theory, it is challenging in practice.

Synthesis of the interview data is relatively straightforward, because multiple grid interviews can be handled in the same way as the multiple interviews generated by any qualitative study (for example, Saldana, 2009). However, as Hadley and Grogan (2023) indicate, the analysis of multiple numeric grids is challenging and there is no consensus about how best to use the grid in a research context.

Using grids of supplied elements and constructs

One possible approach is to pre-specify both the grid's elements and its constructs *a-priori*, and then to ask a number of participants to score the same grid. There are strong analytical advantages to this "survey-type" approach. If it is chosen, shared elements and constructs can be elicited either by asking a representative group of individuals to construct a grid as a focus group exercise, or by using content analysis on several

individual interviews can be to sort the data into themes that “seem to represent what the group is saying” (Fransella et al., 2004a, p. 48). These themes can then be used as shared constructs in a single, research grid that is given to a larger number of people (Fransella et al., 2004a). Focus group discussions and individual in-depth interviews each have advantages and disadvantages but, while focus groups may be more effective in eliciting sensitive information (Guest et al., 2017), there is a concern that group discussions do not reflect well the views of individual participants because groups seek to reach consensus. There is empirical evidence that individual interviews generate both a broader range of themes (Guest et al., 2017) and more in-depth information about individual attitudes and beliefs (Stokes & Bergin, 2006) than do focus groups.

Supplying both constructs and elements, and asking participants to score the same grid generates data that are easy to analyse, but there are theoretical reasons why this is unsatisfactory. Simplifying analysis by supplying the participants with elements – the things they are construing *about* - is fairly uncontroversial (Jankowicz, 2004c), but the use of their own, elicited, *personal* constructs, using their own vocabulary, is generally preferred to the use of supplied constructs because these are likely to be more meaningful to the participant (Hadley & Grogan, 2023; Jankowicz, 2004a; Mak et al., 2013); even though, as Hadley and Grogan (2023) point out, this can result in a “cacophony of constructs.” The challenge lies is making sense of this cacophony without losing information. The techniques for doing this are all based on some form of grouping in order to present data in manageable chunks, and this can either involve the grouping of constructs or, less often, the grouping of individual grids if the different construing of subgroups of participants is to be compared (Atieno et al., 2023).

Options for analysing multiple grids of individual constructs

Content analysis can be used to analyse the presence and frequency of different ideas in a group of constructs. As described by Jankowicz (2004a), this involves the sorting of constructs into either categories that are data-driven and created by the researcher, or categories that are theory-driven and pre-specified, such as the general psychological system proposed by Feixas at al (2002). After sorting, the constructs are analysed within categories and the results are expressed as summary tables that indicate the frequency of their use – perhaps with a comparison of different frequencies between subgroups of participants. However, while the claims from the frequency table can be supported with text data, the numeric data from the rating of element on construct has been lost (Jankowicz, 2004a).

Honey (1979) reported a different approach to grouping that utilises the scoring data in the grid. As well as eliciting the participant's personal constructs, he or she is also given a supplied, superordinate construct to rate. The personal constructs are then sorted based on their similarity with the superordinate construct. In Honey's example, which synthesised 73 individual grids in order to establish how people constructed effective management, the superordinate construct was "most effective at handling people – least effective at handling people." The closer a construct's scoring was is the superordinate construct, the closer it is to how somebody "sees" effective management. However, while Honey's technique usefully identifies the "top" and "bottom" parts of the grid data for analysis, the middle part of the data may not be utilised.

Finally, an approach that has been used in the food and hospitality sector is the Generalised Procrustes Analysis (Chang & Mak, 2018; Mak et al., 2013; Messina et al., 2008). In this approach, the data from multiple grids are made comparable by mathematical manipulation – centring and stretching the data, so that individual differences in mean scores or use of the scale are removed, before individual grids are rotated until the patterns of difference and similarity between elements matches as closely as possible, and a "consensus grid" showing patterns of similarity and difference in the construing of elements is created. The constructs that are most closely aligned with the consensus grid are then selected and superimposed to create a biplot. The approach is appealing because outliers – constructs and participants who do not match the consensus grid – can be identified using Analysis of Variance (ANOVA) and examined, but data is also lost. An ANOVA test showing that 64% of the variance is explained by the consensus grid with 36% residual variance, is considered to show "moderate to high" agreement among the grids (Mak et al., 2013). In addition, the small number of constructs selected for display on the biplot may not show a coherent explanation for the clustering of elements. For example, in Grice's (2009) worked example of students' constructions of their peers, the biplot shows students clustered on a main axis that includes contradictory characteristics at either pole – with nice/pretending to like someone/big liar/afraid to talk; at one pole, and loud/shy/making new friends/too egocentric on the other. It is difficult to know how to interpret a biplot where contradictory characteristics are clustered together, and this difficulty probably arises from loss of detail.

The theory-driven analysis of multiple grids

In Chapter 2, I argued for theory-driven research in which hypotheses derived from a theory in the middle-range could be used to test, modify or reject that theory. If it is the concepts and relationships implied in the theory that are to be tested against the empirical data, then these concepts and relationships are the most appropriate framework to use for analysis. The “cacophony of constructs” can, I argue, be adequately organised, with little loss of data, by sorting them into theoretically derived categories and analysing both interview and grid data within each category to show shared construing. By using the framework flexibly, the data can test, modify and possibly reject the theory and “verification research” is avoided. This approach will be discussed in more detail in the “Methods” chapter, which follows.

In the remainder of this chapter, I will frame the repertory grid as a mixed methods approach, showing how the repertory grid meets the integration challenge, before describing some of the other methodological choices in grid research.

The repertory grid as a type of mixed method

Although not conventionally regarded as a mixed method, the repertory grid has recently been proposed as an “advanced mixed methods” tool (Fetters, 2019; Hadley & Grogan, 2023), with advanced mixed methods being understood as those in which analysis goes “beyond the descriptive" and contributes to “higher order theory building”, and in which sophisticated methods are used to integrate data (Fetters, 2019). It is useful to frame the repertory grid as a mixed methodology because this focuses attention on the “integration challenge”, the specification of how data are integrated and how the combination of

qualitative and quantitative data contributes knowledge that is greater than the sum of their parts (Fetters & Freshwater, 2015).

The repertory grid meets the integration challenge

A repertory grid interview is a "concurrent triangulation" study in Creswell's (2003) typology, in that qualitative and quantitative data are collected at the same time, with equal value being given to both data types. The grid also offers the potential for tight integration of data analysis: the constructs offered by the participants are *their* ways of thinking about the field of enquiry, and it is therefore logical to import the whole set of constructs into qualitative data analysis software and to use them to code the interview data. The construct-codes could then be sorted into theoretically informed groups in an iterative fashion, and the resulting groups mapped onto the "best fit" theory, while expanding and modifying the theory to accommodate the data.

Using constructs to code the interview data and assigning both constructs and text data to the same theoretical categories, means that the advantages of both types of data can be leveraged: biplots offer powerful visual representations of the relationships between elements and constructs in a given theoretically defined category, and linked text data coded within the same theme can be used to support and explain inferences drawn from the biplot and to indicate causal linkages (Maxwell, 2004). At the same time, the interpretive work of qualitative analysis and the subjective selection of representative quotes can be balanced by biplots that show constructions across the whole group for that theme.

Other methodological decisions for repertory grid based research

The repertory grid is a flexible tool, that should perhaps be thought of as a suite of approaches for which several methodological decisions have to be made (Fransella et al., 2004c). In the example I have given in this chapter, and in the main empirical work reported here, I have used a numeric grid. However, qualitative grids are also described in the clinical setting; in these the matrix is populated with text segments rather than scores (Proctor & Winter, 2020). Several other methodological decisions are required when grids are used as tools to assess shared constructions, in particular the following:

- Which elements to use
- For a quantitative grid, what sort of rating or ranking scale should be used?
- For a quantitative grid, how many elements and constructs are needed, and how many people should be interviewed?

Each of these will be discussed in turn.

Choosing elements

Elements need to be chosen that are not only meaningful to the participants, but which map out the area of interest. Jankowicz (2004b) suggests that supplied elements can be thought as “triangulation points” that map out the landscape of enquiry, while being close enough in meaning for participants to identify patterns of similarity and difference. Testing elements during a pilot study helps to identify a set of suitable elements and I will describe the process of selecting and testing a set of supplied elements in Chapter 6.

Ranking or rating scale for the grid?

Kelly's (1955) original grid asked participants to rate elements on a two point scale, indicating to which pole of the construct each element belonged. Grids in common use today use longer rating scales, that allow participants to express their ratings more precisely, or they ask participants to rank elements. The problem with ranking is that it forces elements into a symmetrical distribution that may not be appropriate (Fransella et al., 2004f). A scale of 1-7 is commonly used on rating grids because participants are unlikely to be able to make the finer distinctions necessary for a scale longer than this (Fransella et al., 2004f). However, a scale of 1-5 is attractive because the familiar Likert scale makes a 1-5 scale recognisable.

Sample size

Decisions need to be made about how many elements to use, how many constructs to elicit from each participant, and how many participants to interview. Sufficient elements to map out the topic must be chosen, but too many make the grid interview tiring for the participant. Completing a grid is hard work for the participant and fatigue is usually the factor limiting the size of an individual's grid (Proctor & Winter, 2020). Jankowicz (2004b) suggests using 6-12 elements, while Proctor and Winter (2020) indicate that including more than 15 constructs or elements in an individual grid is rarely of value because participants are unlikely to be able to make considered judgements with grids that are too large.

In research settings, decisions also need to be made about the number of participants to include. These decisions are usually made either by a "rule of thumb" that recommends a

sample size of 15-25 interviews (Heckmann & Burk, 2017), or by continuing interviews until the data are saturated (i.e. no new themes emerge). In two reports that examined saturation of shared constructs, saturation was reached in 17 interviews (Napier et al., 2009) and 20 interviews (van de Kerkhof et al., 2009) respectively, indicating that a sample size of 20 may be adequate.

Although the standard sample size calculations used in quantitative analysis cannot be used because most parameters are unknown, Mark Heckmann (2017) has designed some open source software called Gridsampler that allows users to simulate the consequences of changing the sample size. The software answers the generic question:

"*What is the probability of obtaining a result where at least C percent of the [groups of shared constructs] contain a minimum of M [constructs] when using the sample size N?*" (Heckmann & Burk, 2017)

Gridsampler ran 1,000 simulations and indicated that with a sample size of 20 and 10 identified themes, each theme should contain at least 4 constructs with almost 100% certainty, supporting the adequacy of a sample size of 20.

Ethical considerations

The study was approved by the Central University Research Ethics Committee (number ED-CIA-20-199). It is a low risk study that does not ask for sensitive information or protected characteristics, and participants were given a small voucher in return for their time. Students were approached via a student organisation and I also placed a paper notice on a college notice board. However, these yielded no volunteers, so I approached

students directly in the teaching hospital's Surgical Emergency Unit. Most said "yes" immediately but, if they hesitated, I offered to provide my email address in case they wanted to think about it. In this way, I was able to recruit participants while avoiding coercion. Participants were given a printed participant information sheet prior to the interview, and provided written, informed consent.

This recruitment process introduced the possibility of selection bias because it is possible that students who declined were struggling academically, or felt critical about teaching and did not wish to share this. If this was the case, important perspectives may have been omitted. There is no way of knowing if this happened and it needs to be taken into account during interpretation. However, only two or three of the students I approached did not immediately accept the invitation to participate, and one of those was preparing for a major televised sporting event while studying for the final clinical year. In addition, it was quite clear that the participants who did take part had no problem sharing strong opinions about some teaching.

Data security is an important aspect of ethical research, but it is relatively uncontroversial. The steps I took to preserve confidentiality and prevent data loss will be outlined in Chapter 6.

Reflexivity

In Chapter 2 I examined, and rejected, the idea that a researcher can approach a study with a completely open mind. Even when designing a randomised, controlled trial, a researcher approaches the trial with ideas and assumptions that have influenced the

choice of study question and design, and must go to some lengths to neutralise bias in the execution of the study and interpretation of results (see, for example, Higgins & Thomas, 2019). In research based on interviews, the prior experiences and world views of the researcher are also likely to influence the study design, but may particularly affect the nature of the discussion with participants, and the interpretation of interview data. Instead of trying to neutralise these influences, it is considered good practice instead to give a detailed account of them, so that readers can better interpret the study's claims (Malterud, 2001; Olmos-Vega et al., 2023). In this section I will offer a reflexive account that is based on the scheme recommended by Olmos-Vega *et al*. (2023), and will examine personal, interpersonal, methodological and contextual positioning.

Personal reflexivity

An account of the researcher's "prior experiences and motivations" (Olmos-Vega et al., 2023) is necessary in order for readers to see how these may have shaped decision-making during the study, and my changing views about digital learning over the past 10 years are probably relevant here. I was an undergraduate in the 1980s, before digital technology became part of everyday life. In this era, information was largely derived from books that were either valued possessions, or were library items that were reserved for an evening read. I remember discovering Massive Open Online Courses (MOOCs) in 2013, and being astonished by being able to access so much free, high quality teaching. I enrolled on Stanford's Database Management course, thinking it would tell me how to use Microsoft Access properly but, instead, found myself grappling with the SQL and JSON programming languages and ideas about big data. It was difficult, but I was delighted with my very marginal pass mark in the final exam and became a regular MOOC user over the

next few years. Having spent most of my adult life working in sub-Saharan Africa, where access to high quality education is limited and expensive, I saw digital education as the key to a bright new future where everybody could learn from the world's best universities, once the digital infrastructure was in place. However, I was constantly puzzled by the patterns of participation: in a course where thousands had enrolled, there were generally less than 10 of us using the discussion forums. I wondered whether this might be explained by fear of exposure, or difficulty formulating questions, or perhaps something else that was perhaps related to participants' cultural or educational background.

In 2017, I enrolled in a part-time Masters course at Oxford that had a large online component, and I witnessed the same phenomenon regarding discussion forums: there would be a flurry of correspondence in the first week after the usually highly stimulating face-to-face teaching week, but this very quickly decayed until, by weeks 5 or 6, there would be only one or two people posting and responding. It seemed highly unlikely that lack of participation in this context was a result of diffidence driven by cultural or educational difference. When I first had the opportunity to start a doctorate in education, I thought that the use of discussion forums would be an interesting phenomenon to explore, until later persuaded that students use other channels, such as the WhatsApp social media channel, to communicate with each other, and that discussion forums could be considered a little dated. I then decided to look at digital learning engagement more broadly, particularly when my initial literature reviews identified the very low completion rates for MOOCs (Laurillard & Kennedy, 2017; Terras & Ramsay, 2015), and data suggesting that many students had a persistent preference for face-to-face teaching

(Kemp & Grieve, 2014; Pedrosa-de-Jesus et al., 2014; Raupach et al., 2009). At the time, these behaviours and preferences were to me strangely inexplicable.

During this time, my own views on digital learning started to change. I'm not entirely sure what was behind this, but suspect that my move to a non-consultant NHS job may have been partly responsible: suddenly, I not only had to spend hours on compulsory digital training for skills I was never likely to need, but my clinical practice was constrained and directed by badly designed digital systems – the digital no longer felt like a tool under my control and for my benefit, but something that was being used to control me for the benefit of managers, and I had no desire to spend time online voluntarily after leaving work at the end of the day. However, I still felt that these negative experiences of the digital reflected issues about design and use, and that the bright digital future was still there, if only people would get their design right. This assumption was behind my early choice of design research to investigate digital learning engagement (see Appendix B), which was discontinued largely because students' kind comments about my digital learning designs were not matched by actual use of them.

My feelings about digital learning changed further during the Covid-19 pandemic: I was invited to teach Research Design and Methodology to a group of Masters in Education students over two terms and, while it was a highly enriching experience for me, I was acutely aware of how much my socially-distancing students were missing out on, as they sat at their computers on the other side of the world. Video-conferenced "socials", in which everybody clasped their own cup of coffee on screen, did not compensate for the lack of face-to-face contact and I believe it was a thoroughly dreary experience for them.

My embryonic visceral dislike of the digital medium grew after the pandemic, when some activities that could have returned to normal remained online for the sake of cost and convenience.

The personal attitude that I brought to the grid interviews reported in this thesis was, therefore, one of a digital-teaching convert, turned apostate, and I assumed that at least some of the participants would share the involuntary feelings of annoyance and gritting of teeth that I had started to experience with both digital learning and video-conferenced meetings. I chose a method that was thought to "get under the surface" of how people thought, by identifying the patterns through which they appraised particular areas of experience (Heckmann & Burk, 2017), and a theoretical framework that made "gut feelings" into a legitimate object of enquiry by recognising both the motivating power of affective response, and their physical nature. My position also meant that I was on the look out for comments that would help me to understand where my growing, visceral dislike of the digital came from. While I was aware of this and made an effort to explore and to present positive comments about digital teaching and learning, this attitude almost certainly influenced my interpretation of the grid data and the students' comments I identified as most interesting.

Interpersonal reflexivity

I was an "insider" during the grid interviews, in that I was still a part-time member of the clinical team in the Surgical Emergency Unit from where the students were recruited. I feel that I was a relatively "benign" outsider, because I was not responsible for the students' assessment, and I had not delivered any of the digital teaching that we were

discussing, so there was little fear of offence. I also had not met any of the students before recruitment, so there was no pressure to "pay back" time that I might have spent teaching them during their clinical attachment.

However, medicine is hierarchical and I am a person with grey hair, some decades of clinical experience, and was obviously known to the nursing staff and junior doctors alongside whom the students were working when I approached them. Although I was careful to avoid coercion during recruitment, might our different positions in the medical hierarchy have influenced how questions were answered? It is difficult to answer this with any certainty but, before planning the grid interviews, I had carried out some standard interviews for the design research that is reported in Appendix B. A memo I wrote after the first four standard interviews, included the following comment:

> *I need to be careful about my own position. The interviews sometimes felt like an academic interview more than a conversation (I had a feeling that they were sometimes looking for the "right" answer) and they may have been wishing to please. It is also possible that users may be unhelpfully polite about the artefacts created by this project. [Note from memos March-April 2021]*

Interestingly, although some of my grid interviewees were less confident than others, I did not get the sense of them trying to get the "right answer" from any of the grid interviews; and I think this is probably related to the type of questioning, which is much more specifically related to objects: "what difference do you see here?" or "which of these do you prefer and why?"; rather than to personal experience: "tell me about a digital learning experience that worked well for you." Ironically, by directing my questions to objects rather than directly asking about their experiences, I found I was able to elicit participants' feelings about learning media far more effectively than if I had asked them directly.

Methodological Reflexivity

I approached this work from a Western research paradigm that was informed by rational, Enlightenment philosophy, because I believe this has been successful in advancing useful human knowledge and because it is aligned with the medical science paradigm in which I have been trained. This limited the theoretical framing of the study by excluding popular, contemporary post-modern approaches, such as Actor Network Theory, and Critical Theory.

As noted earlier, the repertory grid can be considered a type of mixed method, and I initially had some difficulty with the epistemic positioning of mixed methods because the choice of qualitative or quantitative methods is often interpreted as a "cipher" for "underlying philosophical ideas" about the nature of knowledge, such as constructivism and positivism respectively, and these are incommensurate (Bryman, 2008). Mixed methods researchers respond to the problem of mixing incommensurate epistemologies by adopting a "pragmatic" philosophy, but this is often interpreted as pushing questions about what counts as acceptable knowledge to one side, and adopting whatever view is most appropriate for a given research method (Bryman, 2008; Creswell et al., 2003). I found this unsatisfactory, but it also seems not to do justice to Pragmatic philosophy as described by CS Peirce and outlined in the earlier section on Theoretical Triangulation (see pp. 54-55). In the choice of methodology, as in the choice of theory, I chose to take Peirce's abductive view – that our knowledge of a real phenomenon is strengthened when the phenomenon is examined from different perspectives and results converge, making it legitimate to draw conclusions about a phenomenon using both qualitative and quantitative data.

Contextual reflexivity

In seeking to create transferrable knowledge, it was necessary to reflect on the particular context of the students' learning, which was far from typical. The participants had successfully applied to join a highly competitive course in a prestigious university and so, at the very least, can be considered to have a successful track record of studying. The situation in which the students found themselves during the Covid-19 pandemic was also abnormal; they had been exposed to a great deal of digital teaching, that had been prepared a short notice by teachers who were largely unprepared and who may have been facing a surge in their clinical caseload. The implications of these issue for the study findings are considered in more detail on pp. 154-159 .

6. Methods

In this short chapter, I will specify the approach I used in a set of repertory grid interviews that used supplied elements and elicited constructs to test a hypothesis about learning engagement derived from Tomkins' theories. There are two distinctive features about the methods used here that were justified in the previous chapter, but are worth re-iterating here. Firstly, the elicited constructs were used to generate a numeric repertory grid that reflected the students' scoring patterns in the usual way, but the constructs were also used for coding the qualitative data in the transcripts of the interviews in which they were discussed. In this way, there was tight integration of quantitative and qualitative methods for both data collection and data analysis. Secondly, the constructs were grouped and mapped onto a framework that was generated from the hypothesis, but was adapted and expanded to accommodate emergent findings. This meant that both the construct scoring patterns and the interview data could be mapped onto theoretically defined categories and the data for each category examined as a whole. This provided a theoretically-driven method for examining the large number of elicited constructs provided by multiple grids.

Specification of a-priori coding framework

An analytical framework based on the middle-range script theoretical hypothesis was specified *a-priori*.

The overall hypothesis was:

Online learning tends to activate scripts of superficial engagement and facile termination of activities, that have been fostered by other online activities (in a context of choice overload).

This hypothesis suggests that online learning and other online activities are recognised as similar scenes, and activate similar learning engagement scripts, and that these are different from the scripts activated by face-to-face learning. An *a-priori* organising framework that shows online learning, other online activities and face-to-face learning activating affect-laden, scripted responses that determine learning behaviour is shown in Figure 6.1

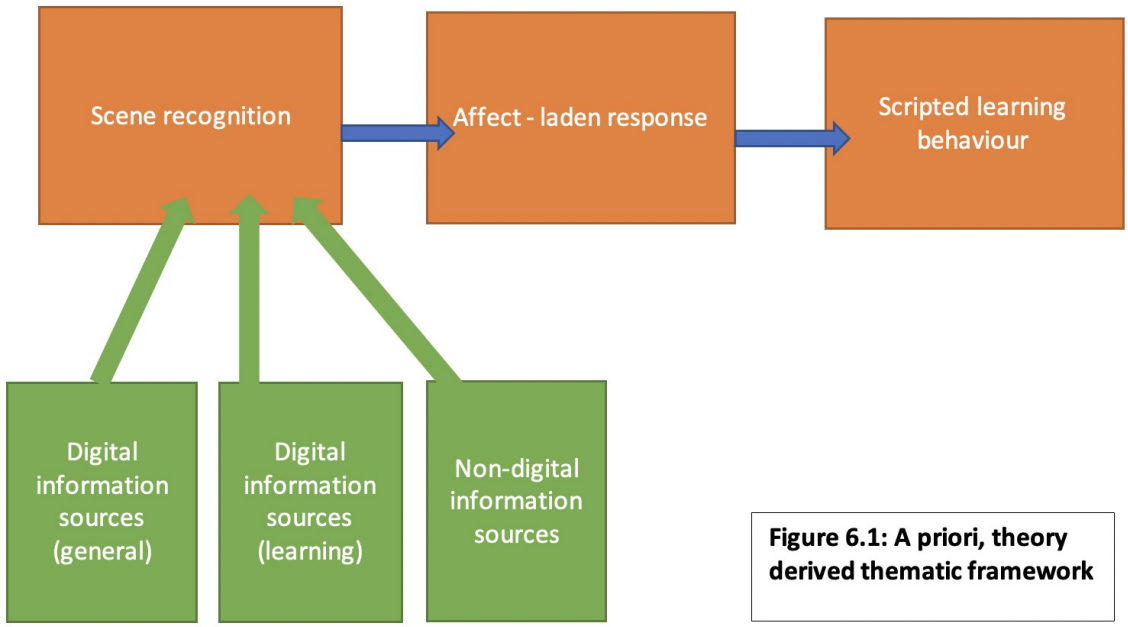

Figure 6.1: A priori, theory derived thematic framework

Piloting and selection of supplied elements

Three pilot repertory grid interviews, not used in the final analysis, were used to test and develop a set of 12 supplied elements that adequately mapped out the topic, and which were similar enough to each other to generate constructs from. Medical students were not used for the pilots. Instead, two interviews were carried out with a student of education and one with a teacher. The topic was stated as “different ways of getting information, in terms of how you use, and perhaps feel about, them.” Four elements were chosen to represent online learning activities, four represented face-to-face learning activities and four represented general internet use. One of the elements from the pilot was changed during the first medical-student grid interview in the main study: “small group discussions” was removed from the group of face-to-face activities, and replaced with face-to-face tutorials, because the latter are a significant feature of Oxford education and the student reported little use of small group discussions in the medical curriculum. The other 11 elements were found to be representative of students' experience of “different ways of getting information.”

The final set of elements is shown in Table 6.1. The elements were chosen to represent the formal and self-directed digital learning resources that made up the greater part of students’ digital learning experiences during the Covid-19 pandemic, together with the modes of digital communication that they were most likely to use, and the traditional forms of teaching delivery.

Reading and responding to emails
Watching an asynchronous (recorded) lecture
Attending a face-to-face lecture
Doing a Google search
Watching a synchronous (live) lecture via video-conference
Attending a face-to-face tutorial
Using social media
Reading an online article for learning
Reading from a paper book for learning
Watching YouTube videos
Using the discussion forum in an online classroom
Taking a patient's history

Table 6.1: Supplied elements for repertory grid interviews

Data Collection

Following the pilot study, twenty medical students were recruited and completed repertory grid interviews using the set of elements that had been developed. Clinical medical students who were attached to the Surgical Emergency Unit were approached directly and invited to participate, with the aim of recruiting "typical" medical students. The only personal characteristics recorded were gender, year of study, and whether they were graduate or undergraduate students. I deliberately did not collect more personal details because this may have led to identification of participants, who were recruited from a fairly small pool. The nature and structure of their prior experiences of digital teaching and learning was also not probed before the start of the grid interview. The

reason for this is that I drew on Kelly's Commonality Corollary, which states that "to the extent that one person employs a construction of experience that is similar to that employed by another, his processes are psychologically similar to the other person" (Fransella et al., 2004a, p. 10), and made an assumption of shared construing in a group of clinical medical students in the same university, all of whom had recently experienced a prolonged, unanticipated, and rapidly organised switch to digital teaching in their course.

Constructs were elicited using triadic elicitation: students were asked to identify discriminating features and their opposites when shown sets of three cards drawn from a set of twelve cards on which the supplied elements shown in Table 6.1 were written. Once the student had identified a characteristic that discriminated between the elements, he or she was asked to identify or confirm the opposite. Constructs were probed using Hinkle's (1965) "laddering" technique, asking the student which pole of the construct they preferred when learning and why – the reasons for the preference that emerged from the discussion were used to create further constructs. Students then scored their own constructs against the 12 supplied elements. The 20 students volunteered a total of 179 constructs. Participant 011 suggested a superordinate construct of *low value-to-high value*. This was given to the remaining nine participants as an additional supplied construct, resulting in a total of 188 constructs. The full list of constructs is reported in Appendix C.

Data handling

The grid interviews were recorded and then transcribed verbatim. The transcripts were imported as documents into Atlas-ti qualitative data analysis software, version 9.1.1 (ATLAS ti Scientific Software GmbH, Berlin). The list of constructs was also imported into Atlas-ti, for use as a code list (see Appendix C).

The construct-codes were grouped with similar construct-codes and sorted into themes in an iterative fashion, using the process described by Attride-Stirling in which a basic theme encapsulates a discreet object or idea but needs to be read in the context of other themes to make sense "beyond its immediate meaning" (Attride-Stirling, 2001, p. 389). As far as was possible, the basic themes were mapped onto the pre-specified organising framework shown in Figure 6.1, but the pre-specified, super-ordinate themes in the framework were extended and expanded as necessary to accommodate emerging data. The modified coding framework is shown in Figure 6.2. The super-ordinate theme "type of information source" was created to incorporate the pre-specified three groups of elements, together with new basic themes about their affordances; while the super-ordinate theme "learning behaviours and thinking" was derived from the pre-specified theme of "scripted learning behaviours" but expanded to accommodate new basic themes about learning that emerged from the data. Another important basic theme that emerged from the data rather than being pre-specified was "Perceptions". The transcripts were then read as a whole and were coded using this coding framework.

The quantitative data in the 20 grids was combined in an Excel spreadsheet to create a single table with 188 rows and 12 columns. Excel data were imported into R Studio

2022.07.1+554 "Spotted Wakerobin" Release (RStudio Team, 2022) for use with R version 4.2.1 (R Core Team, 2022) and formatted for the “OpenRepGrid” package version 0.1.12 (Heckmann, 2014).

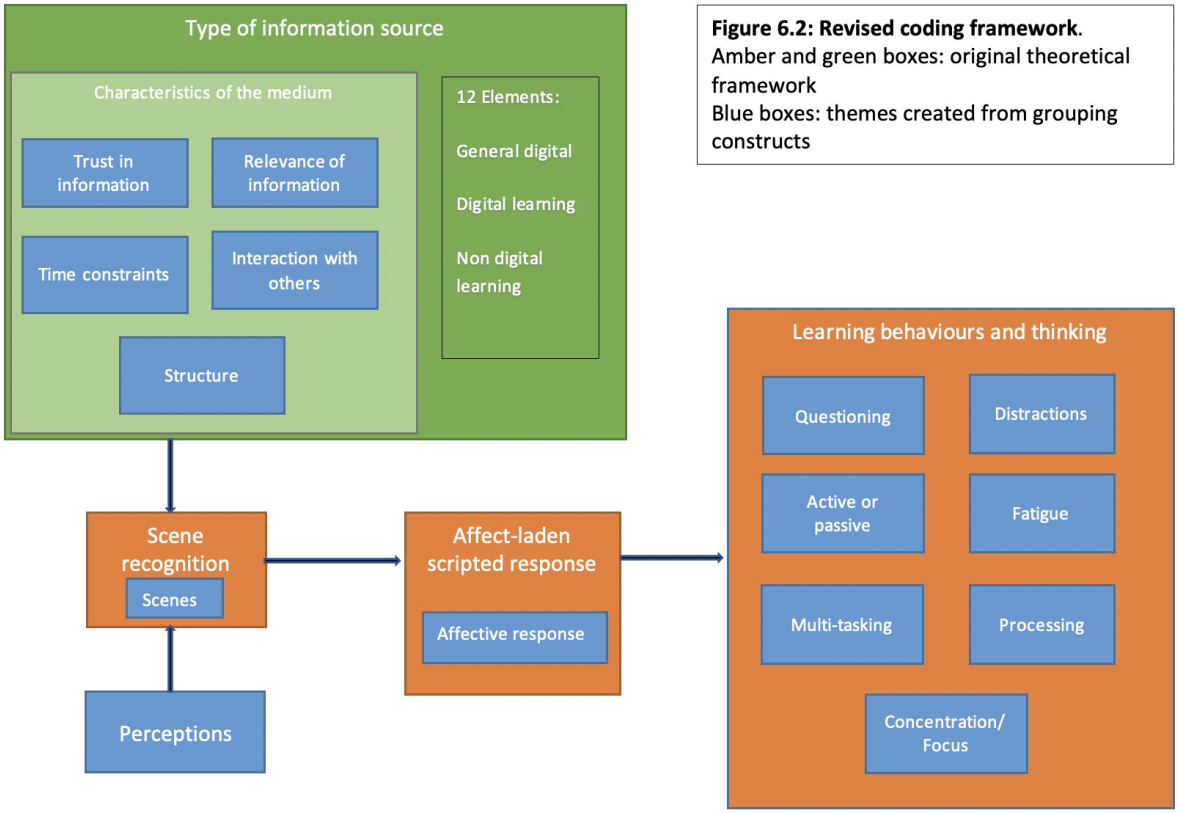

Figure 6.2: Revised coding framework.
Amber and green boxes: original theoretical framework
Blue boxes: themes created from grouping constructs

Data Analysis

An initial principal components analysis was run across all the data to look for overall patterns of similar construction between the 12 elements using the “Factoextra” R package (Kassambara & Mundt, 2020). Following this, both qualitative and quantitative data were analysed within the theoretically derived themes shown in Figure 6.2. Text segments for each theme were extracted and read as a whole across the document set, looking for the underlying “story” in each theme and looking for connections between themes. Biplots were also created for each theme, representing the numerical grid data

for all the constructs grouped in that theme across all 20 participants. Two dimensional biplots were selected because they provided considerably greater clarity than three-dimensional visualisations without significant loss of information in the third dimension. This is explained further in Appendix D, together with two examples. For each theme, biplots of the first two dimensions in the data were presented together with the interpretation of the qualitative data.

Data Security

Recordings were made on a password protected laptop computer with an encrypted hard drive. Transcripts were anonymised, assigning a number to each participant. Hard copies of the grids were identified by first name only and were kept in a pre-specified office location. Transcripts and the Excel spreadsheet were backed up to a secure Cloud location.

7. Results (1): Testing of middle-range script theoretical hypothesis

Twenty students (8 males and 12 females) were recruited and completed repertory grid interviews taking a median of 60 minutes (range 38 to 88 minutes). Eleven students were in the undergraduate programme and nine were graduate entry students. Fourteen students were in their first of three clinical years, one was in the second clinical year, and five students were in their final year. The format of digital teaching they experienced was heterogenous: the pivot to an online format was necessarily rapid during Covid-related lockdowns, and this meant that teachers did the best they could, offering a mix of live and recorded presentations, with a range of interactivity and segmentation of content. Students supplemented the digital teaching provided by the university with the self-directed use of digital resources, such as YouTube. On the whole, students stated that they preferred media that included interactive elements and reported that technical problems, when they happened, did interfere with learning. The following results reflect their experiences over the range of teaching and learning approaches and the comparison focuses on the different constructions of digital and face-to-face learning in general, rather than specific design features within digital teaching. In this chapter, the script theoretical hypotheses derived in an earlier chapter will be tested against the empirical data. These hypotheses were:

Overarching script theoretical hypothesis:

Online learning tends to activate scripts of superficial engagement and facile termination of activities, that have been fostered by other online activities

Testable hypothesis 1:

There is a family of *related scenes* that determine engagement with educational *and* non-educational materials encountered in the online environment. In other words:

a. Digital educational and digital non-educational materials are seen as representing a similar class of situations and
b. They activate similar feelings and behaviours (superficial engagement and easy termination of activities)

Testable hypothesis 2:

Face-to-face learning has a higher ratio of positive to negative affects than does online learning

Testable hypothesis 3:

There is a differential magnification of excitement-interest between online and face-to-face learning activities

In the following sections, data are largely presented within themes. Two-dimensional biplots are used to show how the elements are distributed against the constructs within each theme, while text extracts from the interviews are used to support the arguments made for and against each hypothesis, and to look specifically for evidence of causal relationships. However, Hypothesis 1a also requires a global assessment of the overall pattern of element scoring against all constructs that will be presented first.

Hypothesis 1a: Digital educational and digital non-educational materials are seen as representing a similar class of situations

If digital learning and non-learning materials are seen as representing a similar class of situations, the patterns of construct rating should be similar and thereby different from the ratings for face-to-face learning. A global assessment of whether this is the case can be made using a principal components analysis (PCA) of the patterns of response by element. This is shown in Figure 7.1. In this figure, similarly constructed elements will point to the same side of the graph, with differently constructed elements pointing in the opposite direction. The contribution of each element to variation in the data matrix is also indicated by the length of the arrow and its colour – elements with long, red arrows contribute more variance and are therefore more salient in distinguishing between elements than short, blue arrows.

Other than the use of the chat box to ask and answer questions during videoconferencing, which is a non-salient element, all the learning media and YouTube videos point North on the vertical axis of this graph, while the other three non-learning digital media point South. On the horizontal axis, the three face-to-face learning elements are differently constructed to all other elements. This “global” representation of construct rating does not support the hypothesis that digital learning and digital non-learning activities represent a similar class of situations for students; it suggests – perhaps not surprisingly – that digital learning elements are similarly constructed to face-to-face learning elements for some constructs, and similarly constructed to general digital use for others. The vertical axis (first principal component on this plot) represents 32.9% of the variation, compared to 17.7% represented by the horizontal axis (second principal

component). This means that more variation is explained by different constructions of learning activities *versus* non-learning activities, than is explained by different constructions of face-to-face versus digital activities.

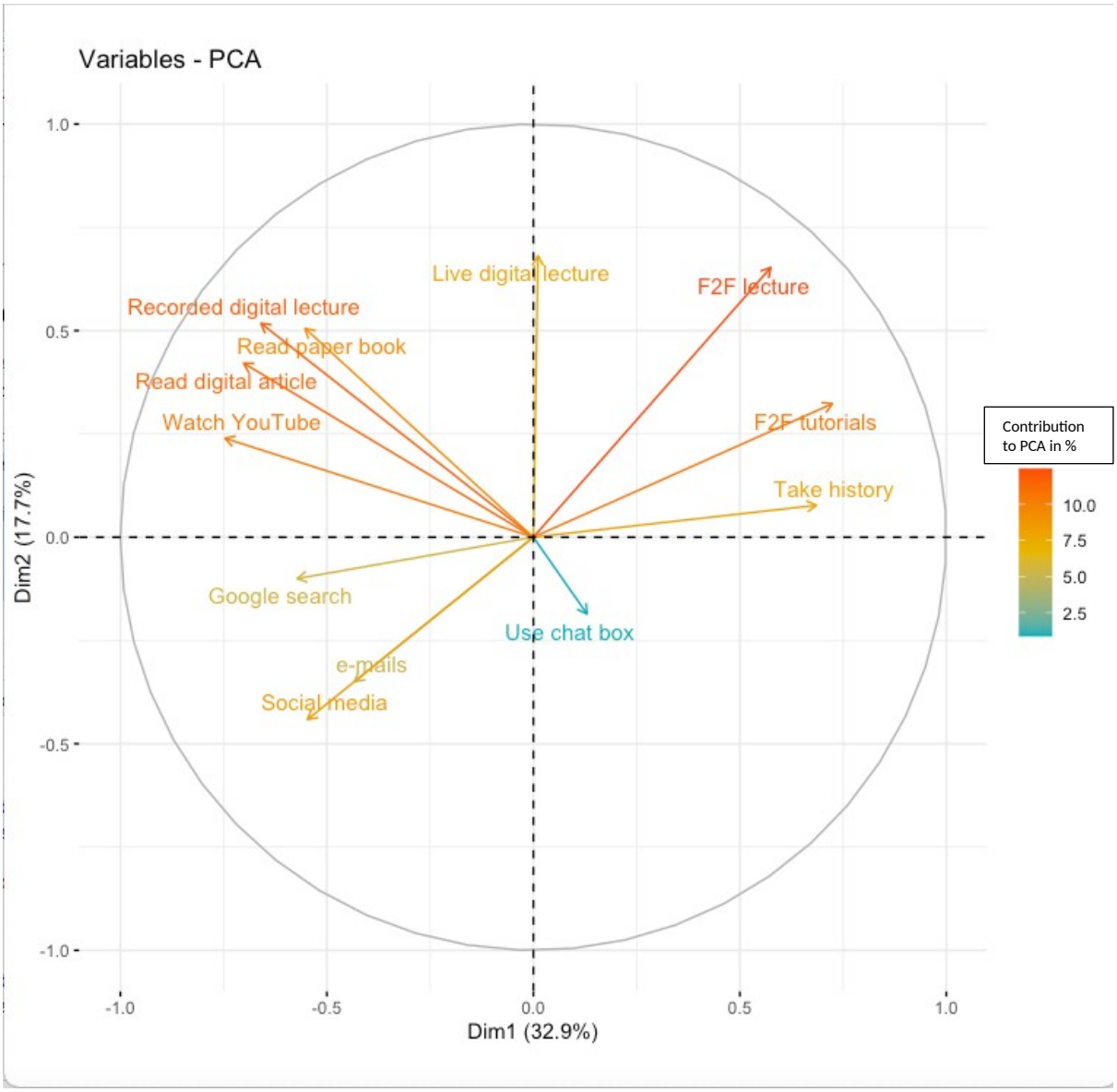

Figure 7.1: Principal Components Analysis (PCA) of elements showing correlations between response patterns for the 12 different elements.

Scene Recognition

A theme related to testable hypothesis 1 is Scene Recognition and, although Figure 7.1, which shows the relationships between the elements across the whole dataset, did not support the broad claim that digital learning is recognised as belonging to a similar class of situations to general online activities, the data coded within the theme "Scene Recognition" did support the claim that scene recognition is important when learning. A biplot for scene recognition is shown in Figure 7.2.

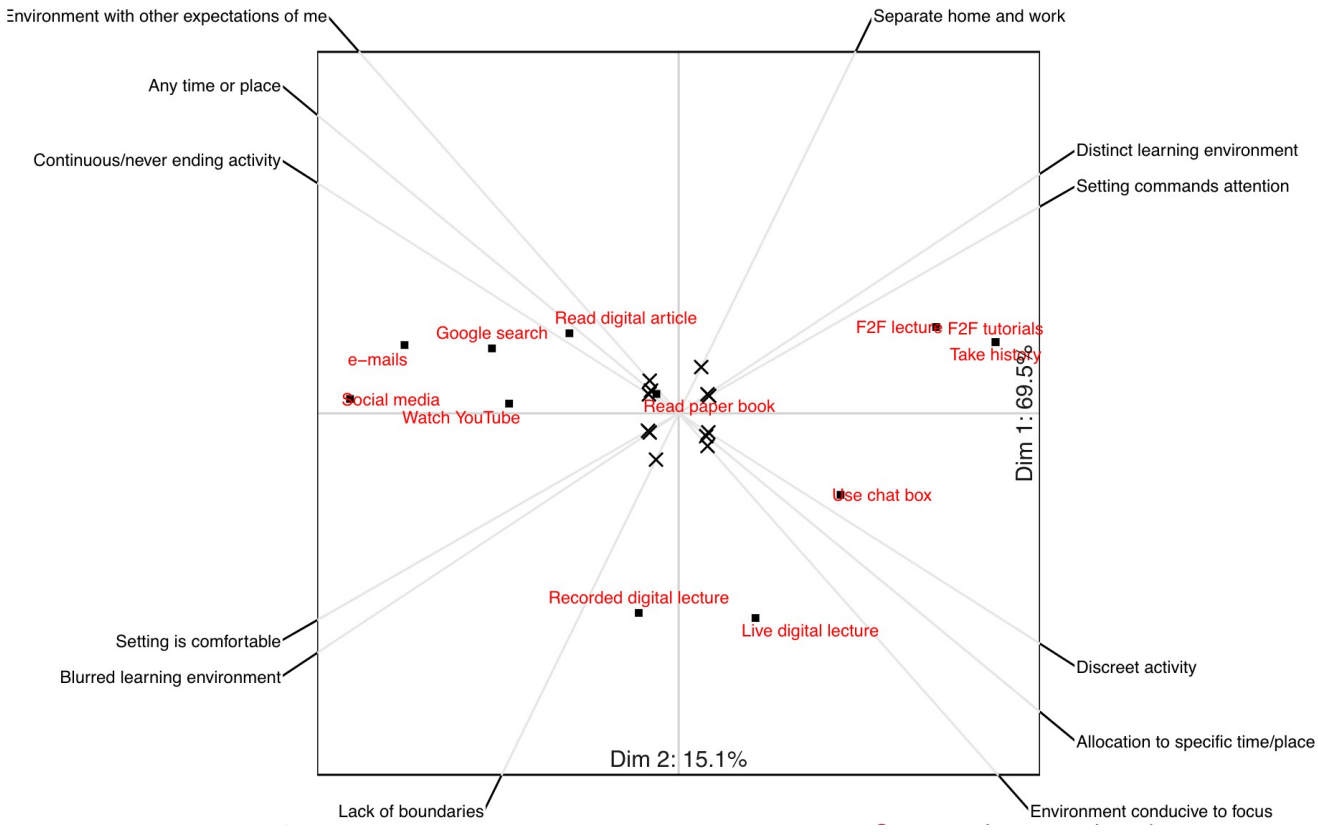

Figure 7.2: Biplot showing constructions within the theme "Scenes"

In this plot, the horizontal dimension represents 69% of the variation of the data within the theme. This means that elements clustered on the right are differently constructed to elements clustered on the left. The constructs that have contributed to this distribution can be read off on the periphery of the graph. Students drew a distinction between learning that took place in a recognised learning environment, and the “anytime, anywhere” learning that digital media made possible. A distinctive online learning scene was not recognised, instead digital learning was described as taking place in a context that blurred the boundaries between home and work.

While appreciating the convenience of digital learning, several students indicated that they felt they learned better in a recognised learning context:

> *There's just something about being in a learning environment physically, that's conducive to good learning, as far as I'm concerned. [P003]*

> *Definitely, for me, I think there's a thing about getting up, getting ready, going to a place, and it's sort of your purpose is to go and learn at that place. And then when you get back, you can decompress... And I feel like I absorb things better. Whereas, if you're at home, there's no separation. And you're constantly either in work or relaxed mode. And I don't think that's particularly healthy or productive for you. [P018]*

Several students opted to create a recognisable learning context when using digital resources, for example by watching digital lectures in the library:

> *if I stay at home all day watching lectures, I go stir crazy. I can't do it.*
> *.... I often find that I just get into a very weird headspace of being quite unproductive and feeling like I'm not learning anything. And then getting anxious about that, whereas if I separate it and go to the library, then I get into a good routine. I can go out and get coffee, and then once I've walked home, I'm home and I can actually relax. [P019]*

For some students, digital lectures were also associated with unpleasant, COVID-related scenes:

> *I: Do you know why you don't like [digital lectures]?*
>
> *P: I don't know, I just find it difficult to... they're like almost not real. And I just don't feel like I'm fully in a study mode. Whereas if I go to a lecture face-to-face, or a face-to-face tutorial, it's like you're kind of in the setup, you're there to learn... I don't know. I just really don't like them because they really remind me of COVID and all this. It's just a lot of negativity associated with digital lectures and I don't like it. [P014]*

The interview data and the biplot therefore offer support to Tomkins' claim that scene recognition is a determinant of behavioural response, indicating that learning in a recognised learning environment supports attention and focus because it is the "purpose" of the place.

Hypothesis 1b: Digital learning and general online activities activate similar feelings and behaviours (superficial engagement and easy termination of activities)

Within the overarching category of learning behaviours and thinking, themes were created for Focus and Concentration, Distractions, Multi-tasking and for Processing. These will be considered next.

Focus and Concentration

Constructs for the themes Focus and Concentration, Distractions and Multi-tasking have been combined in the biplot shown in Figure 7.3. Digital and face-to-face learning were differently constructed, with digital learning seen as a challenge to sustained attention.

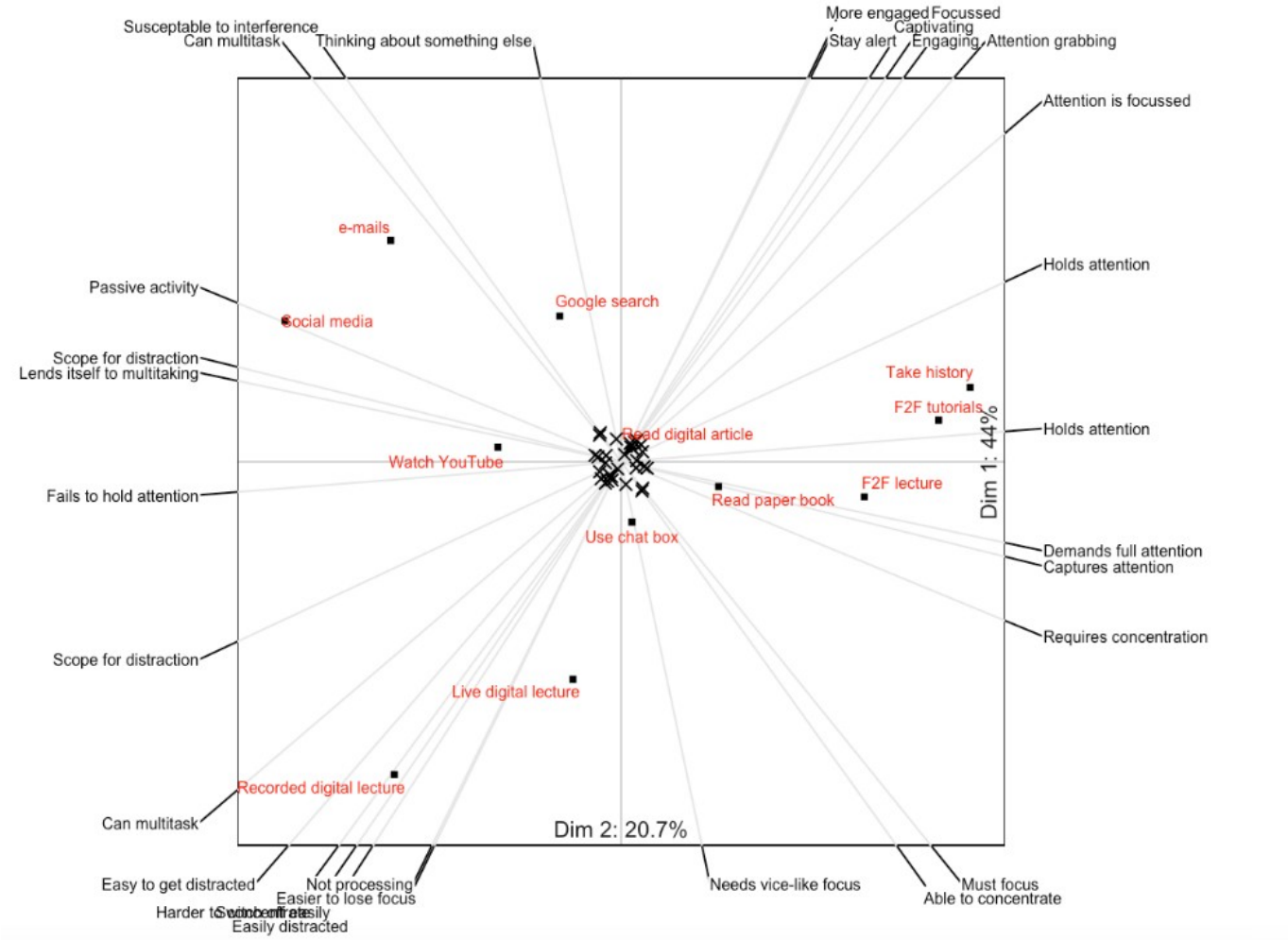

Figure 7.3: Biplot showing construction of elements within the themes “Focus and Concentration”, “Distractions” and “Multi-tasking”

For some, distractions tended to be self-generated rather than environmental, with solitary learning lowering the threshold for giving in to the distractor, particularly when at home:

> *No, I don't think I'm distracted by sounds at home. I'm more distracted by the prospect of doing something else on the computer at the same time, things like that. It's very easy to just load up Twitter [laughs]. Or if you've got other people in the house to talk to them. Or go and make coffee, or something like that. [P018]*

The impact of potential environmental distractors on focus and concentration differed between face-to-face and digital environments, as can be seen in these two contrasting texts:

> *Or [in the Emergency Department], you know, there's always some sort baseline noise, just, you know, people screaming or someone like running away from the police or, there's always something. And yet, I don't mind that. [P003]*

> *So, for instance, yesterday I was in a Teams seminar and someone clearly decided that it was appropriate to do the Teams thing from probably an office in a ward in the hospital, and obviously, you could hear all kinds of noises. And that was enough for me to just completely decide that I was going to do something else. I think I practised sutures instead of watching the lecture [P016]*

The evidence did not support the hypothesis that students follow scripted behaviours of more superficial engagement and easy termination of activities that have been fostered by other online activities. Firstly, there was no convincing evidence that this group of students engaged in a superficial manner with digital learning materials. Although it was clear that students found it considerably more difficult to give sustained attention to digital than face-to-face media, they dealt with this using a number of strategies. For recorded digital lectures, they often played the recordings at higher speeds and took frequent breaks. They also rewound and replayed recordings when they felt they had missed something, although one participant described an unpleasant feeling of compulsion to keep repeating segments:

> *..you go: Oh, I just missed that. I need to repeat it, I missed it again, I need to repeat it, I still haven't got it, I need to repeat it. And then you find that what was an hour lecture, which you've watched double speed, now takes two hours. Because you keep repeating 10 seconds, 10 seconds, 10 seconds. Actually, it's quite reassuring to know that I wasn't alone in that description. I've had a couple of conversations with people who do exactly the same thing. [P020]*

Several of the participants noted that recorded lectures took a long time to watch as a result of taking breaks, either to look something up or to rest, and there was a feeling that recorded lectures were sometimes provided less selectively than they would have been if instructors realised how much time they took to watch properly. The risk of recorded lectures becoming a “brain dump”, where it was difficult for students to identify what material was necessary and important was mentioned. However, live digital lectures were seen as particularly problematic for some participants, combining the worst of the digital and face-to-face worlds: not only was it difficult to maintain focus, but the live format offered no opportunity for students to control the pace or revisit material if their minds wandered and they missed content. Students reported migrating to their phones or other activities during both digital lecture formats.

There was also little evidence of learned patterns of superficial engagement and choice switching for the elements that represented general digital use. Although some students admitted spending more time on media such as TikTok and Instagram than they would like to, students were all aware of the risk of time wasting when using social media and several had used strategies to avoid this by cancelling social media accounts or setting phone alerts if they exceeded a defined time limit. Students also used social media for learning and reported using social media to signpost them to more in depth material, or integrating social media with other media:

> *quite commonly, something like the BMJ or other journals will post on social media, and I follow them on social media. So then I, it's not uncommon that I will be using social media and then end up reading an article through that, because they've posted it… there are both fantastic, just purely articles, and then also articles with dynamic content, including YouTube videos…. I think that's commonly how people, certainly my generation, consume information. [P003]*

Processing

The biplot for the theme "Processing" is shown in Figure 7.4. The clustering of the elements is not so clear for this theme. The horizontal axis (first dimension) explains 45% of the variation in the data and largely represents constructs that construct active learning or processing against the passive reception of information. Both face-to-face and recorded lectures are seen on the passive side of the graph, while Google searches and emails join face-to-face tutorials and history taking on the active side of the graph. Eighteen percent of the variation is explained by the second principal component, which represents constructs that place retention of information against "floating words." On this axis, face-to-face activities and reading are scored as fostering retention of information whereas digital learning activities are placed on the other side of the graph.

The text data also indicated that for some students, the face-to-face environment fostered concentration and the active processing of information:

> *I think when you attend to face-to-face you, you're kind of digesting and then thinking about what you're going to say next. Whereas in a book or recorded lecture, you're not thinking about what you're going to say you're just…taking in information. [P009]*

> *I: So, can we maybe go back? So you expressed a strong preference for non digital at the beginning, do you know what it is about non digital that you prefer?*
>
> *P: From a lecture point of view, I just think, often, you're nowhere near as present, in terms of your concentration.[P017]*

However, for others, the ability to revisit materials meant that asynchronous learning fostered deeper learning.

> *I have no doubt that watching the recorded digital lecture, because I can constantly access both the slides contents and the commentary on them, allows me a much more in depth access to the knowledge contained within the lecture in that either a live digital lecture or a face-to-face lecture, because I can always like read, listen to whatever the person said. However, that also means that it takes me a lot more time to get through the lecture content. [P016]*

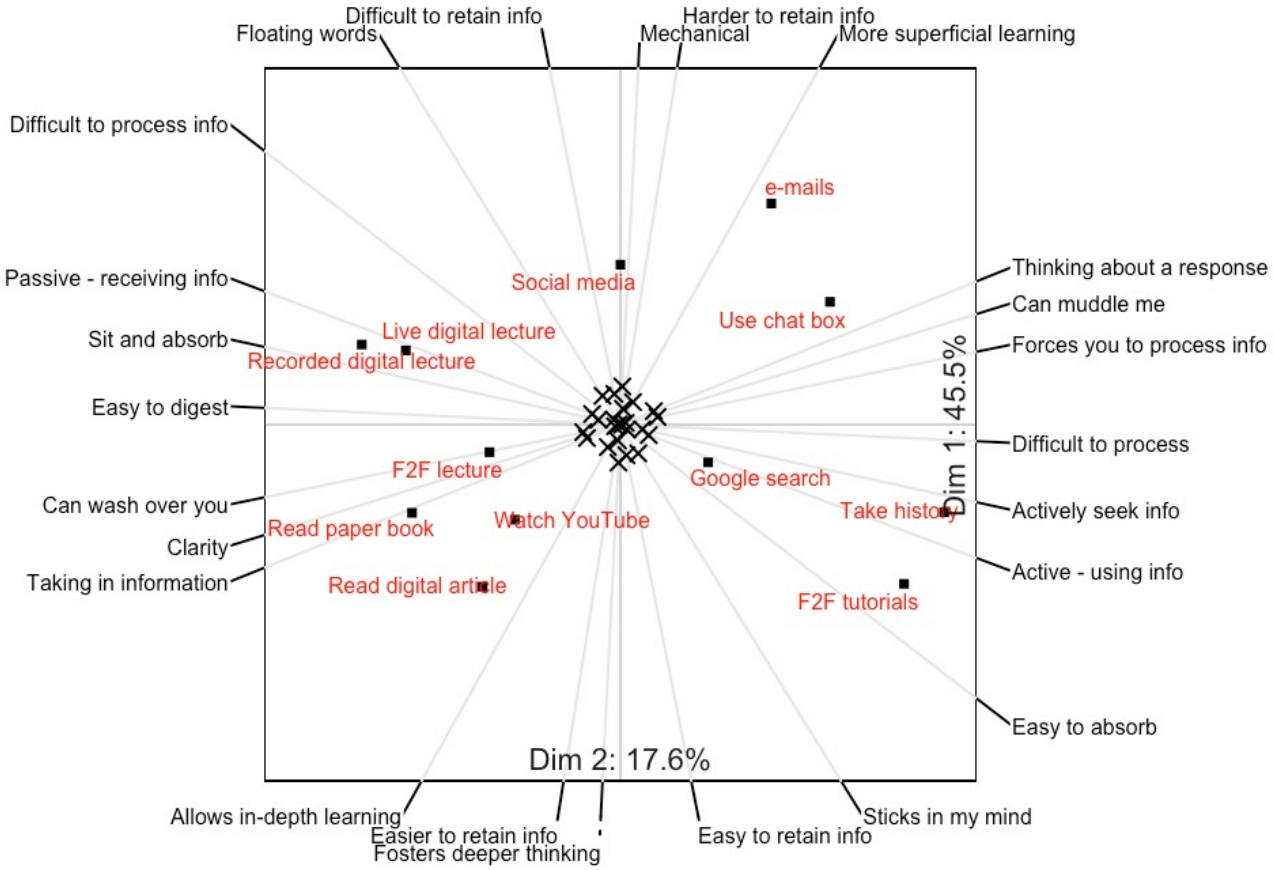

Figure 7.4 Biplot for constructs within the theme “Processing”

In summary, Hypothesis 1 is not supported by the data. The similarities in construction are greater for the two classes of learning activities versus non-learning digital activities, than they are for the two classes of digital activity versus face-to-face activity. The claim that digital learning and non-learning digital activities are “seen as similar classes of situation” is therefore rejected. The claim that the two classes of digital activity activate scripted responses of superficial engagement and early termination of activity is also not

supported by the evidence. Students were aware that the digital environment made them prone to distraction and used strategies to try to focus on digital learning content and to limit their exposure to social media. However, Tomkins' ideas more broadly are supported: several students indicated that they learned better in a designated learning environment, because that was the "purpose" of the place. The "scene" provides meaning and thereby influences behaviour.

Hypothesis 2: Face-to-face learning has a higher ratio of positive to negative affects than does online learning
AND Hypothesis 3. There is a differential magnification of excitement-interest between online and face-to-face learning activities

Affective Response

Twenty one constructs were classified within the theme "Affective Response". A biplot showing how the elements were distributed against constructs that were categorised as affective is shown in Figure 7.5.

Face-to-face learning that involves interaction with other humans is distributed along axes that represent greater stress, but more excitement and interest than digital learning. Face-to-face tutorials and taking clinical histories in particular are clustered around poles that express positive affects, while digital learning media are more closely associated with

poles that express tiredness and anomie. This supports the hypothesis that excitement and interest is more likely to be stimulated by face-to-face learning media.

Context where worry about other people

Context where confident

Figure 7.5: Biplot showing elements within the theme “Affective”

The magnification of interest-excitement in face-to-face learning was also reflected in the text analysis: while students commented favourably on the convenience of online learning, strongly expressed affective responses invariably favoured face-to-face learning. Live digital lectures evoked some particularly strong responses:

> *I HATE this live digital. Because it's just like, I’m getting all the negatives of both of them. I just don't like this at all. Because for [face-to-face lectures], I'm there and I'm paying attention and I can see the person lecturing and so I'm paying attention... in [live digital lectures], you don't get the person in front of you, because you don't really see their face, right? You just see their slides, which makes it just super impersonal, which makes you not inherently like pay attention less, and you can't go back to the information... and you're forced to go at their speed. And it's just, it sucks. I don't like it. [P006]*

> *P: I just feel like this [live digital] to me, emotionally is so different to a face-to-face lecture, which is obviously a one.*
> *I: Which emotion in particular?*
> *P: Like in terms of my engagement and interest and like enjoyment. Enjoyment is probably the right word. Whereas watching a live digital lecture, it's fine, but it's not kind of something that I look forward to in anywhere near the same way as going to something face-to-face. [P017]*

> *I actually really, really enjoy, really<> enjoy [face to face] tutorials...And also I don't want it to finish. [P001]*

Anxiety was regularly mentioned, and was associated with three contexts: the use of social media; anxiety about the judgements of others or appearing stupid; and anxiety about being exposed or “put on the spot” when questioned during teaching.

> *there's a pressure to sort of perform well in certain environments. And certainly... if you could be called upon to ask a question. Even in a chat box you can be afraid that you're going to ask a stupid question or say something stupid. Whereas if you're just kind of watching something and don't have any don't have to interact or respond, then there's less pressure in that. [P004]*

[Discussing tutorials]
You're getting taught by someone and there's only two students so it's very…you know, the learning can do in that context is a lot more than maybe in other contexts, just because you don't have to worry about lots of other people being in the room. [P008]

However, some students also recognised that a little anxiety was sometimes beneficial for learning:

you need a little bit of discomfort to be… I think that is so true. Like I think, even within face-to-face tutorials, if you're in a face to face tutorial, where no one asks you questions, no one cares, like, keeps you on your toes at all, you just don't pay attention. Like I don't know, I don't at least. Same on the wards. Like if you're in a ward round and you're just standing there, no one asks you questions, you obviously absorb nothing. [P006]

The fatigue associated with using digital media was frequently mentioned. This was particularly the case with live digital lectures:

it's really exhausting to be in front of the screen. So like, no one wants to sit there and have an elaborate discussion. [P001]

.. it doesn't feel enriching as a way of learning. [P005]

Our finals revision course was, was two weeks of nine to six, on Teams with lectures. And that is, it's surprisingly fatiguing after a while, you really, really, really have to force yourself to be disciplined. Whereas if you were in the room, I think, for whatever reason, you're just more engaged [P003]

Six of the students' constructions included fatigue at one pole. These were:

Draining - Intellectual energy

Draining - Stimulating

Exhausting - Invigorating

Exhausting - Can keep going

Mind numbing- Stimulating

Demoralising - Energised

In five of these six constructions, the opposite pole indicates interest-excitement, indicating that digital fatigue can be considered as an absence of interest-excitement. Given that interest-excitement is an affective response in Tomkins' scheme, digital fatigue can be considered an affective response.

In summary, although the middle-range script theoretical hypothesis advanced to explain superficial digital learning engagement was not supported, the data did support Tomkins' theories in the broad range: physical learning environments are recognised by students as scenes that activate learning behaviour; learning in non-designated environments was experienced as more challenging because it was more prone to distraction, and could be experienced as unpleasant because it resulted in difficulty separating work from leisure. The affect-laden nature of learning, and medium-related, differential magnification of affect were also apparent in both the transcripts and the biplots. In particular, interest-excitement was magnified in face-to-face learning compared to digital learning. Students often constructed fatigue as the opposite end of a dimension that included interest-excitement, suggesting that digital fatigue can usefully be considered an affective response that indicates a lack of interest-excitement when engaging with digital media. Some possible explanations for the differential magnification of interest-excitement between digital and face-to-face learning environments emerged during the grid interviews and these will be explored in the following chapter.

8. Results (2) Emergent Findings

As described in Figure 6.2, the initial theoretical framework was expanded to accommodate emergent findings in the data. An important and unanticipated theme was the students' perceptual experience, which is examined in depth below, together with their constructions about the presence of others when learning. Other emergent themes concerned the affordances of the medium; these were time constraints, the relevance and trust in information, and the "structure" of the learning – for example whether didactic or self-directed. These will each be considered in turn.

Time constraints

The biplot for constructs allocated to the theme "time constraints" is shown in Figure 8.1. Perhaps not surprisingly, most of the variation within this theme (70%) is represented by the first dimension (x axis), which is accounted for by constructs in which most digital activities are constructed as time flexible, and live activities are constructed as time inflexible.

For many students, the ability to control pace was important:

> *But at the same time, kind of watching a recorded lecture... you can - I like the opportunity to pause and stop. And if I do understand, like if it is something quite simple, it doesn't really need further explanation, then it is the most efficient way to get the information. [P004]*

> *I think you learn better if you're like, controlling the speed at which is delivered to you. [P018]*

This was particularly the case for a dyslexic student:

> *...if I miss something in a recorded lecture, I can just skip back and listen to it again. ... I can take as long as I need to process something. Whereas in a live lecture, once it's happened, it's happened. [P007]*

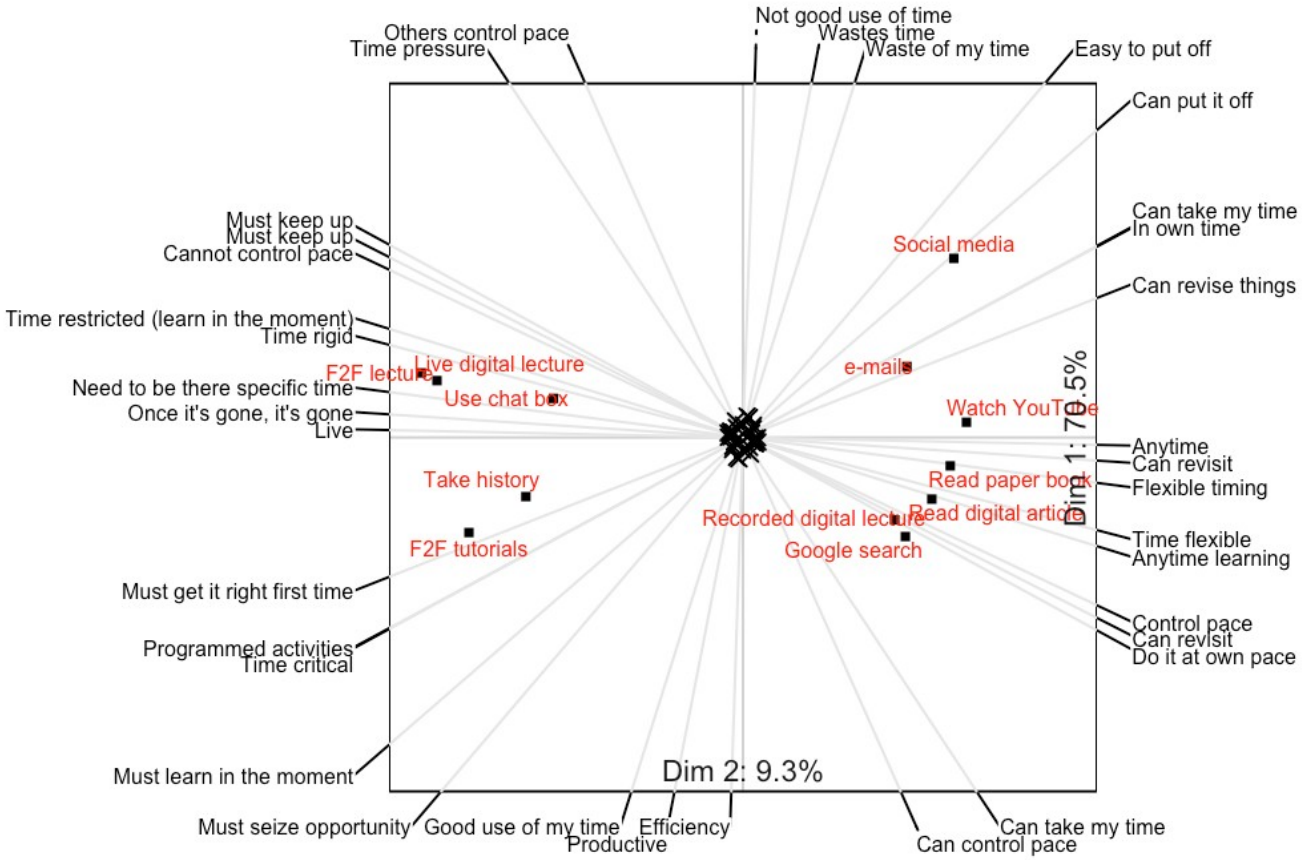

Figure 8.1: Biplot for theme “time constraints”

Another student indicated that asynchronous materials allowed students to choose a study time when they would be most receptive to the material:

> [Discussing live lectures] *...are you feeling up for the lecture or not? It doesn't matter, the lecture is going to happen. So if you want to attend, you attend it, no matter your mental state or that you're tired, maybe you're not in an optimal state to receive new information. Whereas for the recorded one, obviously, you can just get back to it whenever you feel like studying. Maybe you are in a more optimal state to actually learn. [P014]*

But most had mixed feelings:

> *P: I think convenience is the most obvious thing for me... Because, you know, I have to schedule my day around either face-to-face tutorial, or a live digital lecture, whereas a recorded digital lecture I can schedule that around my day.*
>
> *I: Okay. And do you prefer that?*
>
> *P: ...[pause]..Yes... well, not necessarily, because I get more out of the face-to-face tutorial than a digital lecture. But if hypothetically, there was a world in which I could magically appear in a face-to-face tutorial at a time of my choosing, that would be the ideal scenario. But yes, it is more convenient. [P010]*

The comments of some students about time-flexible content were related to the data presented earlier about learning scenes: having a recognised time for learning improved focus and concentration.

> *I: Can I just ask you, which do you prefer... out of needing to be somewhere at a specific time versus flexible timing?*
>
> *P: Needing to be there at a specific time.*
>
> *I: And why?*
>
> *P: Um.. I think it's just I enjoy having a structure and if I have flexible timing, I will get it done eventually. But if I have I have a structure to my day, it gives me ...if I know that I have to be somewhere at 11, I have reason to get out of bed. Whereas if it's flexible, I will kind of try to squeeze it in, or do it in the background. Which is not... I think it has to do with giving us a purpose in a day, in a way. [P015]*

And recorded digital lectures again came in for some strongly affect laden responses that were explicitly linked to focus and concentration:

> *P: Ah, this* [recorded digital lecture] *is the bane of my life.*

I: Why is it the bane of your life?

P: Oh, I find it's really hard to motivate myself if it's asynchronous, because I will, because just my mindset is different from something that I know, if I don't pay attention to this information, it's gone - you know what I mean? This is a thing that's happening now. Whereas, because I know that I can always just go back, I don't pay as much attention, which, which I really should, but it's just the nature of it. I don't like it. [P003]

The ”structure” of the learning

The biplot for the constructs allocate to the theme “Structure” is shown in Figure 8.2. Thirty five percent of the variation in data within this theme is explained by the first dimension (x axis) in which students tended to construct elements according to whether they were seen as active/interactive on the one hand, or passive and non interactive on the other. Reading and the use of recorded lectures are clustered opposite face-to-face tutorials and history taking on this axis.

Several students felt that they learned better when interaction was required:

I think I need to be involved in something in order to actually get anything from it. [P006]

if I was in a tutorial, and someone was continuously just speaking at me, but there wasn't the chance for me to interact, to reply, ask questions, that'd be difficult for me to, to process or absorb that information. [P012]

There are some lectures that have interaction, interactive elements. And I found those easier because there's something going on. [P015]

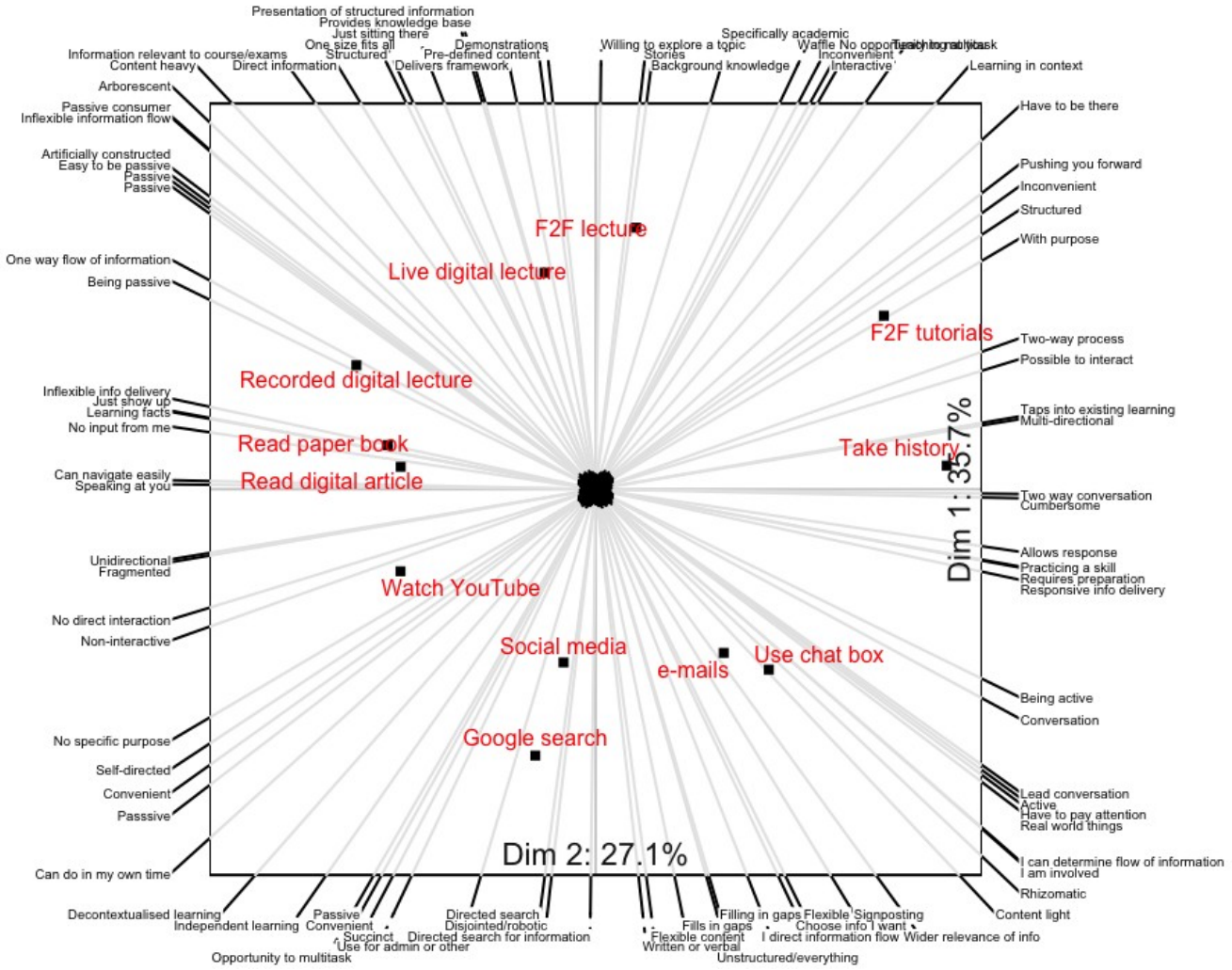

Figure 8.2 Biplot for theme “Structure of learning”

The second dimension (y axis) explains 27% of the variation, mainly contributed by constructs that place user-directed information searches on the one side of the graph, and delivery of structured, pre-defined content on the other. Students saw these two types of delivery as complementary, with lectures as the main source of structured learning, and social media or search engines providing the means to look things up and fill in gaps.

Digital versus paper reading

Although digital and paper reading appear to be similarly constructed on the biplot, differences in use and the sensory and perceptual experience emerged from the discussions. The convenience of e-books and PDF files was appreciated, this was particularly important when students were placed in district hospitals, or when they travelled home. However, digital reading tended to be tabular rather than linear – students would use e-books to look up facts and summaries, and appreciated being able to search and annotate texts. In contrast, paper books were things they liked to own, look at and manipulate, and they were more likely to read whole chapters from paper books. For some students, it was easier to revise from paper books because they had a visual memory of where in the book, or where on a page a particular description could be found.

> *I find it easier to read long sections or process a lot of information from a paper book, whereas I think it's more difficult from a phone, for whatever reason I absorb it less well. [P003]*

> *A lot of the books I read aren't exactly relevant to my learning at all, but I don't feel like they're a complete waste of my time because it's a fun thing to do. [P008]*

> *I: So, tell me a little bit more about what it is you like about paper books?*
> *P: Just being able to hold it, the physical action of holding the book and turning the page…to me feels quite human and quite…I don't know…* [*P009]*

> *I enjoy buying books. And you can't see that if you bought an e book, because you bought it as a file, whereas I enjoy looking at .. my books… maybe there is tactile element to it, as well. But I think it's mainly that it looks different than a screen. And I find the books themselves have a story. And there's a physical object. If I buy, I buy a lot of my books second hand, so there's this element of like, it's been someone else's. That object has a story. And I find that very like…romantic. [P015]*

Quality of information: trust and relevance

The biplot for constructs grouped under the themes “Trust in Information” and “Relevance of Information” is shown in Figure 8.3.

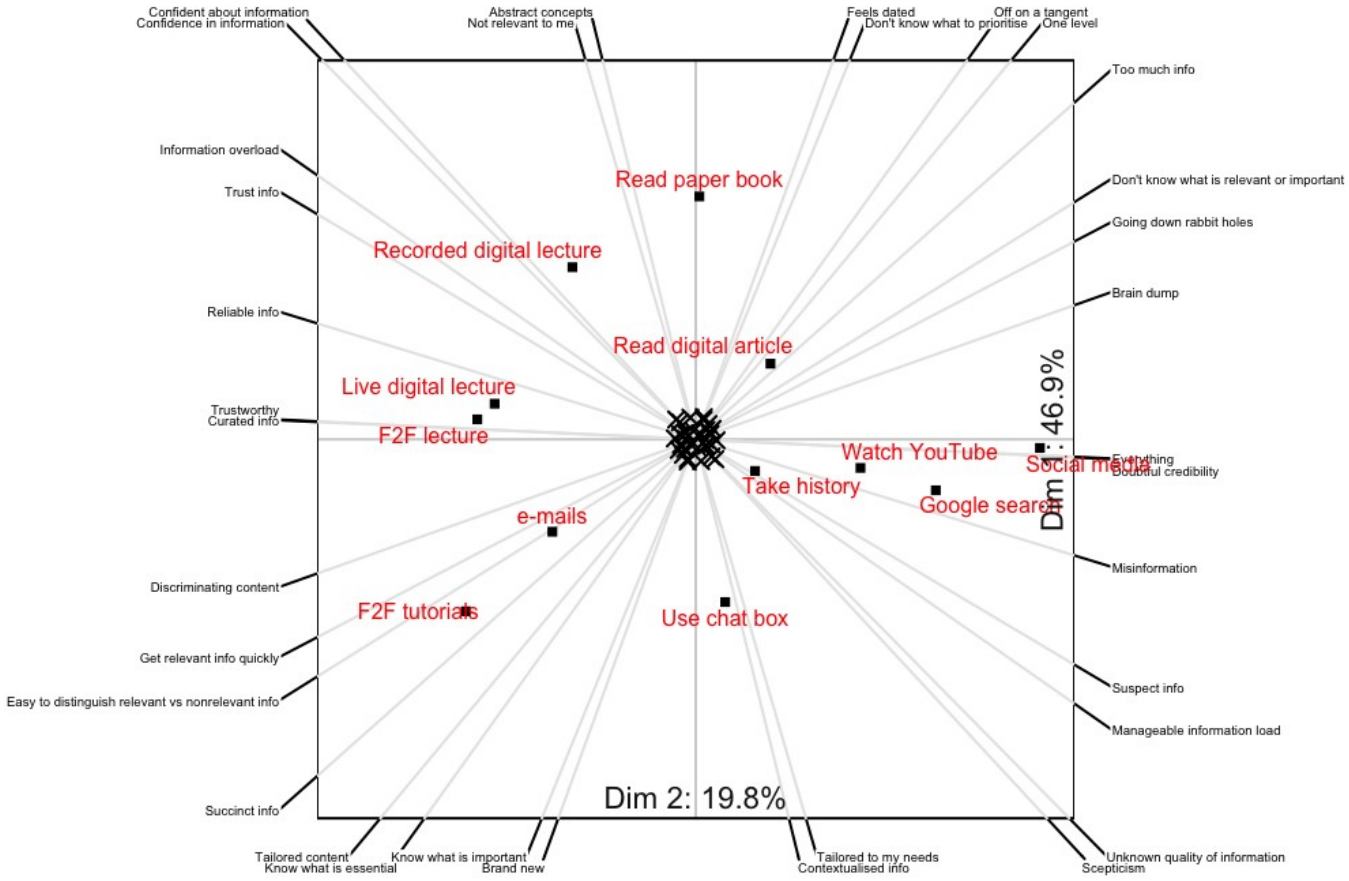

Figure 8.3: Biplot for the themes “Trust in Information” and “Relevance of Information”

The first dimension (x axis) represents 47% of the variation in the data, mainly contributed by constructs that reflect trustworthiness of data or confidence in information. Perhaps not surprisingly, there is a strong theme of distrust in social media and, less so, other publicly available digital information sources, which contrasts with

trust in information given in formal teaching sessions. It might be surprising to see the element “Taking a patient’s history” situated marginally towards the “unreliable” pole, but this reflects the not uncommon student experience of finding a patient’s report is not matched by other sources:

> *sometimes you say "what medical conditions do you have?", and they say "nothing". And then you say "what medications you take?", "oh, I take a statin and my inhalers and blood pressure tablets", and this and that. And you're like, "oh, okay, so you do have medical conditions." [laughing]. [P001]*

The second dimension (y axis) represents 20% of the variation in the data and is dominated by constructs reflecting the relevance of information to the students’ needs. Recorded lectures and books were closer to the “information overload” poles of these constructs than the other elements; recorded lectures because students felt they were sometimes offered indiscriminately, and books because it was difficult to know what was relevant:

> *[In live lectures] most of the lecturers actually think carefully, what information to impart. With this [recorded digital lecture] form, because there's never ever any limit on length, they can sometimes put far too much information in it. A very good example of that is [the] medicine, public health and GP course, where they put something like 70 hours of online recorded materials for you to get through in a six week block, without giving you any time to watch it. [P020]*

> *when I leave a lecture, and we're chatting amongst each other... I usually see that when ... students are like, Oh, that was such a good lecture, it's usually because it's very clear what information is relevant and what you don't need to know. Because otherwise, we're just struggling to know what we need to know, and there's a textbook which has everything. And you're like, do I need to know the epidemiology and like, the prevalence of like heart disease in South Central Asia versus European populations? [P001]*

Perception

A particularly salient, and unexpected, finding was the impoverished perceptual experience that students associated with digital media, with several participants

constructing the elements in terms of limited dimensionality, or a reduction in the numbers of senses used. Figure 8.4 shows a biplot for the thirteen constructs that were classified as relevant to perception. Face-to-face learning tended to be constructed as more real, multi-sensory, human, and responsive.

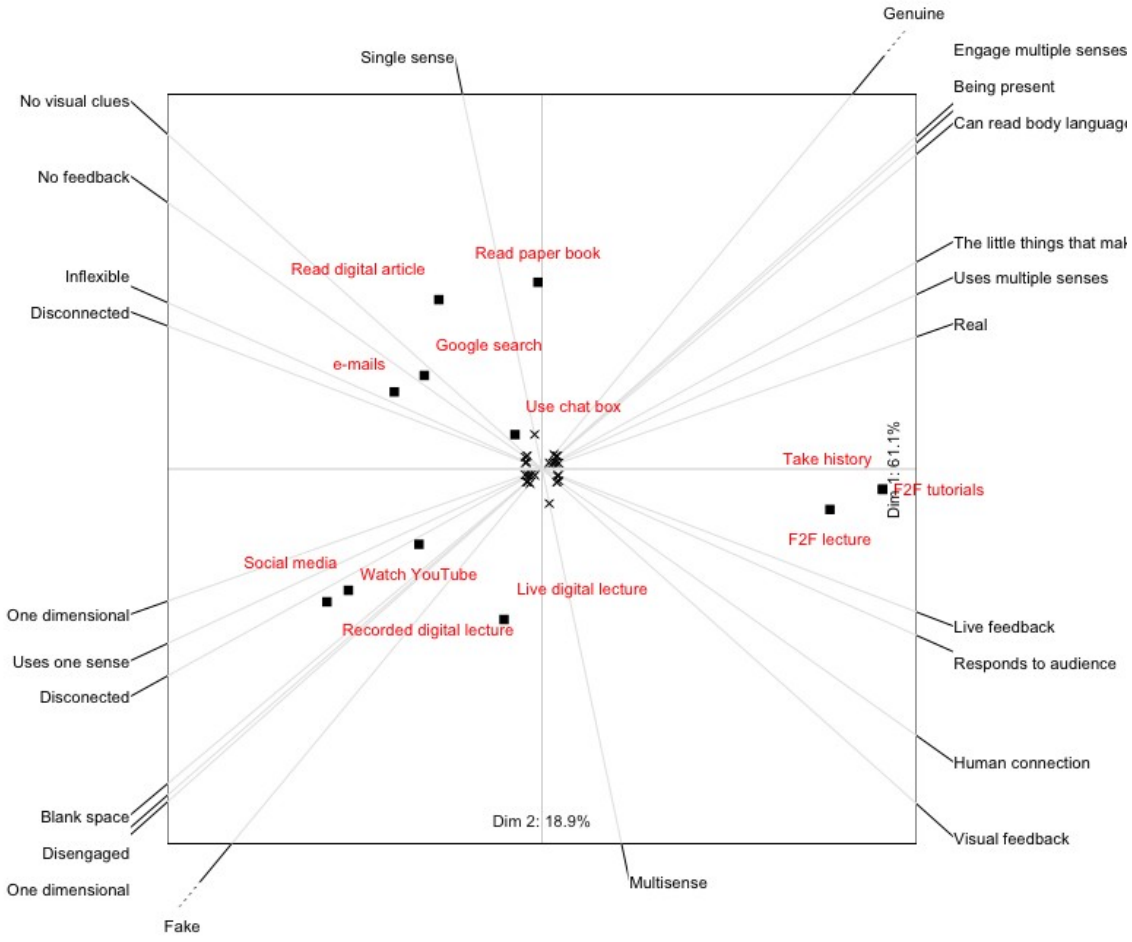

Figure 8.4 Biplot for the theme “Perception”

The perceptual experiences of digital and face-to-face lectures were often contrasted during the discussions, and the impoverished perceptual experience of digital learning was linked by students to loss of concentration or was described as unpleasant:

so you're sat in your bedroom, and you turn on your Teams or you turn on Zoom. ...you, you're there, and it's passive, and you can't... Yes, you can see a tiny square of a human being, but you can't hear the other things in the room, you can't feel the room, you can't see them move. You can't... there's no like palpable understanding of like, an atmosphere. And that's, I find that really jarring to learn from [P005]

I think if we're talking about face-to-face communication, there's loads of interaction that isn't asking questions. You know, just in terms of body language and things like that, you are constantly interacting, which you aren't doing in some sort of digital lecture, whether recorded or live. And yeah, I think that's part of... staying engaged when you're in a face-to-face tutorial, you have to be constantly interacting, even if that's nonverbal stuff. [P010]

these things are happening in front of you at a certain point in time, and for whatever reason, I think it's a, it's a human thing to want to, to pay attention to that [P003]

I: ... so you say that these two hold your attention more than a recorded digital lecture? How would you describe the recorded digital lecture?

P: ...It uses only one of my senses. Okay, so it's somebody talking, but usually there's no visual cue. And that for me, there's more scope for distractions [P015]

Interactions with others

Although digital learning was clearly constructed as a solitary activity, the theme "Opportunity to interact with other people" was quite nuanced and varied between participants. A biplot of the constructs in this theme is shown in Figure 8.5.

Although some participants indicated a preference for learning in groups, where they could learn from others, there was a sense that for others - particularly some of the younger students - larger groups such as lectures were environments where they could not comfortably participate and ask questions for fear of judgement or exposure and for them, the digital space was experienced as safer. Feelings of exposure were expressed regarding face-to- face lectures, and use of the chat box in digital lectures, but less so

with tutorials. Some noted that the presence of other students in tutorials meant that discussions could be derailed, while others appreciated the opportunity to explore ideas and push boundaries in tutorials. Another student indicated that constant interaction with other people could itself be exhausting and there were times when solitary learning was quite welcome.

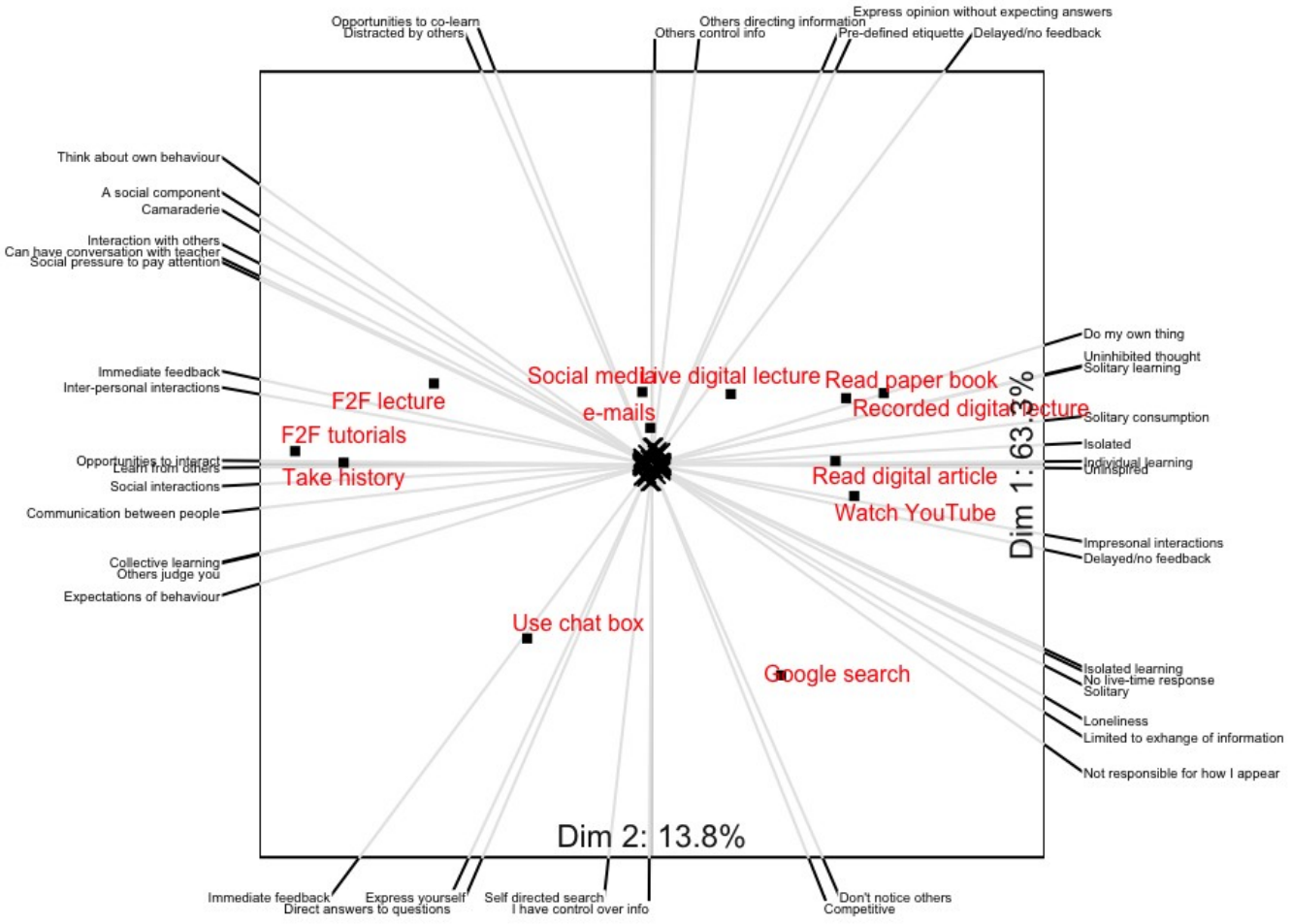

Figure 8.5 Biplot for the theme “Interactions with others”

A frequently noted advantage of social learning was the opportunity to benchmark their understanding against other students, and the importance of those interactions for well-being was recognised:

> *when you're on your own, it's really hard to know whether the lecture you've just heard and didn't understand anything of, did everyone else feel that? Are we missing something? You know, having a reassuring pat on the shoulder go "Oh, yeah, that that lecture was absolutely awful." It is really useful. [P020]*

> *I think there's so much value in those small conversations between lectures as well, as with colleagues. And also, just knowing how your peers are. I think it's, you know, it's very easy for people to get isolated if they're struggling. [P017]*

The real presence of other people was important for many participants, although this was more subtle than "social learning" in the sense of cooperative learning. One participant, was *"[not] a social learner by any stretch of the imagination"* [P020] and described distractions in a face-to-face lecture:

> *P: I always sit front row when I'm in a face-to-face, because I get distracted if I sit any further back, particularly when you sit further and someone in the front row's using Facebook. I know I want to concentrate on the lecture, but I'm now just looking at your Facebook account, and wondering why you're using Facebook in the front row of a lecture. Why can't you go to a back row?*

However:

> *I....So your preference would be not to have those people there?*
>
> *P: No. My preference would be them being there, but all behind me so I don't notice them. [I: Okay], I don't care if they're checking Facebook in the background. [P020]*

In other words, despite identifying as a "non-social" learner, the real presence of other students was valuable to the participant.

Students frequently referred to the lack of “feedback” in digital lectures, describing the importance of small visual cues that allowed the lecturer or tutor to adjust their delivery according to students’ responses. They referred to the lack of human contact with digital media:

> *I think the feedback element to lecturers of seeing people respond to the information given will tailor how the next piece is presented, or slow down something, and there's just an element of, of… like receptivity that you can have… as the teacher, that makes the learning experience more relevant to the audience and therefore more collaborative. And a face-to-face lecture, I always come out feeling like I understood something way more than in an online one [P002]*

Another participant indicated that the reactions of other students influenced the meaning they attached to lecture content. In the following text extract, the student discusses “feedback” which had been identified as a discriminating feature of live teaching:

> *I: What sort of feedback are you thinking about?*
>
> *P: Kind of being able to ask questions and interact, and also looking at other people around the room and what they're responding to. Like if someone else writes something down, I'll go "that's important" and then I'll write it down as well [laughs] P009*

“Feedback” was also offered as a description of real interactions between students and lecturers that allowed lecturers to moderate the pace of delivery:

> *Some of our teaching when it's in person, and they're just trying to get basic principles down, they can see your face, they can gauge, if you're understanding, they can take things down a notch if you look a bit confused. Whereas when it's online, sometimes I find that the lecturers or whoever get quite, you know, get confident, they want to show that they know what they're talking about… And so they…[laughs] kind of pack a lot of information in there. And a lot of times it's just in one ear out the other because you haven't nailed down those basic principles. [P011]*

However, the idea of visual feedback was also used to describe a more subtle sense of connection:

> *you can tell when someone is just delivering a lecture that they've delivered many times before. And especially when, if it's digital, they're getting nothing from you, and it can be a little bit like - just sort of a brick wall between you. [P019]*

> *[P006 had indicated a preference for live lectures]*
> *I: What is it that makes having somebody in front of you with a live lecture...better than the digital lecture?*
>
> *P: It's just more engaging. It's like, you get the visual cue of the person lecturing you, you know that they're paying attention to you and like, you feel pressure to pay attention as well. Whereas like, a live digital lecture, you don't feel like you're being watched. I think that's the main thing, like - face -to-face lecture, you're being watched. And, you know, that person is getting feedback from you guys as well in the audience. Whereas like, here [digital], there's no feedback, there's no interact, there's no connection between the audience and the speaker.[P006]*

> *I think I've realised how important it is to like have a human being. Because it's so much more engaging and interesting because the screen - just like you want to switch off [P001]*

The value of the real presence of others was particularly noted when learning from patients:

> *it sticks in my mind better if I can see the person in my mind, relate what they've got. And things like the symptoms or conditions, I find it a lot easier to go, oh, well, you know, a lady called Mary had that.[P009]*

> *also, perhaps for some people, it is easier to remember things that are more that are associated with stronger emotions. For example, for me personally... if I can kind of, you know, connect a certain illness to a patient I saw and their symptoms, I suddenly, you know, I can visualise this person, and I remember their story. And it's kind of easier for me to, to then put that knowledge into practice, easier to remember and easier to recall, just because it was a real life interaction. [P014]*

Questioning

The presence of others was also relevant to students' feelings about asking questions. One participant expressed a greater degree of comfort in asking questions during digital teaching, indicating that this felt less exposed. Others indicated less comfort posing questions during digital teaching and, although aware of the option of the chat box or the hand raising function on video conferencing software, they tended not to use these.

> *I don't know, I just find it's very inhuman. And therefore it's hard to interact with. I don't know, it's hard to describe...*
> *there's like a consensus that people feel more awkward online. And I think it does boil down to not seeing people, not having them physically there. I don't know what it is about it. It is quite interesting. But I hate it. Like, I hate it....*
> *...It's really hard to pinpoint. And I know it's not a unique experience, because a lot of my friends also feel the same way. I'm not sure why it makes me feel uncomfortable. I think it's just not having eye contact and like, facial responses, you can't see who you're talking to. And I find that very strange.[P018]*

Missing the little things that make us human

Referring to the difference between face-to-face and digital interpersonal interactions, one student made a comment that I found particularly striking when I was trying to make sense of the data in this theme:

> *I suppose you miss out on all the other things that make you human beyond just language. So... I think you become more, not robotic, but more kind of.... I think you lose the, the kind of little things that make us human [P009]*

This comment resonated with several of the students' comments about the importance of the real presence of others and the sense of place for learning, and their enjoyment of the physical properties of books. It raised the question of what it means to be a learning

human and in what ways the perceptual experience might affect a student's ability to sustain attention.

What about game-based learning?

During discussions about focus and concentration, several of the students were asked whether they had tried game-based learning and whether game-based approaches sounded interesting. One student did express an interest, and was sent the file for "An Afternoon of Trivia?" the learning game described earlier in this thesis and in Appendix B, with a request for feedback. It is not clear if the game was played. Other students saw a learning game as "gimmicky" and not a good use of their time. A graduate student with another professional degree and workplace experience made the following comment:

> *And one thing I found very challenging at medical school is the number of resources and different people saying: "oh, you should use this", "you should use that", "I love this kind of app". I mean the number of apps with case based discussions is unreal<>. And I think it's really hard for students to know where and what to use.... I think it's really challenging when you're bombarded with so many things. And the other thing about digital learning is it means that, you know, every Tom Dick and Harry has tried to jump on the bandwagon during COVID: "do our lecture series on preparing for finals" "do our lecture series on preparing for finals". And then the central medical school goes like "oh, we can provide some extra lectures", and then the DGHs are... And it gets to a point where there literally aren't enough hours in the week to do all of these things. And then people get extremely stressed that they're missing out ... unless you're pretty secure and strong, it's horrendous. [P017]*

9. Synthesis of empirical findings

The data reported in the two previous chapters, do not support the script theoretical explanation of digital learning engagement that I proposed earlier, but they do support Tomkins' theories more generally. There was evidence for scene recognition as the stimulus for scripted learning behaviours: the need to make oneself presentable and appear in a designated learning venue at a particular time can be interpreted as recognition of a learning scene, and it was recognised by students as a contributor to effective learning. On the other hand, digital learning did not have a distinct scene and was described as "blurring" into everyday life – to the extent of watching lectures in bed, in pyjamas.

Several affect-laden constructs and comments were also identified and these supported the claim that face-to-face learning, particularly the face-to-face tutorial, is associated with a more positive affective response than is digital learning; some particularly strong negative affects were expressed in regard to live digital lectures. Several participants expressed enjoyment when talking about paper books and this contrasted with a more utilitarian appreciation of the convenience of e-books and PDF files. The negative affect most strongly expressed in discussions, and confirmed in the biplot of affective responses was mental fatigue, something that was associated with distractibility. Drawing on Kelly's idea of thought as bipolar constructs, this can be interpreted as the absence of interest-excitement in Tomkins' affective scheme. This idea is supported in Tomkins' own writing. When discussing some examples of psychopathology, Tomkins indicates that fatigue

happens when interest-excitement are absent, stating: “the phenomenon of excessive fatigue when zest and excitement flag underlines the significance of this positive affect for the maintenance of long-term effort” (S. S. Tomkins, 2008e, p. 193).

However, there was little support for the hypothesis that digital learning media activated scripts of superficial engagement and easy termination that have been fostered by other online activities. The students interviewed were, on the whole, reflective learners who had developed strategies to get the most out of digital learning resources. They were also discriminating in their use of social media, aware of the dangers of time wasting, and several had developed strategies to limit their exposure to social media. Some reported its value in signposting important medical issues or developments, but they were sceptical about its truthfulness, and often used social media in tandem with more orthodox information sources. Emails tended to be read selectively and group or corporate mailings were often deleted unread. Electronic books and articles were appreciated for their portability and searchability, and also because they could be annotated. Students used electronic sources for directed searches and tabular reading, but they generally preferred paper for linear reading. Several students talked about the importance of the book as an object with a history and tactile attributes that gave them enjoyment in a way that a computer file could not.

When comparing digital and face-to-face teaching, the striking difference was not easy termination of digital activities, but the fatigue associated with their use and a genuine difficulty in sustaining attention. My early scoping review [Appendix A] had indicated that live digital teaching was more acceptable to students than asynchronous recorded media,

but this was not supported by the empirical data from the repertory grid interviews. On the whole these students preferred asynchronous recorded media over live digital interactions because of their convenience, and the ability to control pace, rewind and revisit. Live digital discussions were often considered to offer the "worst of both worlds", lacking both the convenience of recorded materials and the sensory richness and feeling of connection expressed in relation to live materials. This perhaps illustrates one of the difficulties in interpreting atheoretical research in medical education: when causal mechanisms are not examined, the positive reports of live digital clinical teaching recorded in the scoping review probably just tell us that students appreciated the efforts that were made to provide them with clinical education during a global health emergency when face-to-face encounters with patients and tutors were no longer safe. They do not give us reliable information about what sort of digital teaching students will enjoy and engage with outside that context.

The students interviewed in this work frequently identified the perceptual poverty of screen-based learning, explicitly linking the general tiresomeness of learning from "behind a screen" with the reduced use of the senses, the reduced number of dimensions involved, and the inability to pick up non-visual cues or "sense" the room. They also strongly disliked not being able to get a sense of other people, something frequently described as missing "feedback" from others. These empirical data suggest that the "little things that make you human" when learning include sensing and deriving affect-laden meanings from places and others. This was an emergent finding that merits examination in greater depth, and I will contextualise it within Tomkins' theories and the notion of the embodied, curious mind in Chapter 11. However, it is firstly useful to seek support for my

claims about the importance of place and person when learning and I will do this in the next chapter, using the perhaps slightly unconventional method of a literary analysis.

10. Literary interlude: The learning human looks for meaning in place and person

It is usual at this stage of a research report to compare and contrast research findings with other, published, empirical reports. There is no body of research on what it means to be a learning human that can usefully serve this purpose, but we can find rich descriptions of subjective experience in works of fiction, particularly works of enduring popularity, whose longevity suggests that they say things that resonate deeply with lived, human experience. In this chapter I will firstly justify this approach, arguing that the novelist has the ability to represent human truths in ways that might not be accessible to other methods. I then examine two well known novels and show how their protagonists experience the importance of place and person when learning in ways that are similar to those reported by the students, re-introducing the concept of perceptual curiosity that was discussed in Chapter 3.

The novel as a data source

Nussbaum (2001b) draws on works of fiction in her detailed examination of the grand emotions of grief, compassion and love, arguing that the literary form is a way of imagining and refining our grasp of emotional attachments to external objects as they unfold over time, and that a place should be made for literature in our accounts of moral issues because it may be that “certain truths about the human being can only be told in a

literary form" (Nussbaum, 2001b, p. 3). Perhaps this strategy can be used, on a considerably more modest scale, to look for evidence that that multi-sensory, three dimensional physical and social environments influence the more mundane emotion of interest-excitement when learning.

Nussbaum describes emotions as "geologic upheavals" that give meaning and texture to our thoughts, a metaphor that she takes from Marcel Proust, whom she describes as "in some ways, the most profound object relations theorist of all" (Nussbaum, 2004). Proust certainly describes the sensory nature of memory creation and recall, most famously in the passage where, after a bite of cake, he recognises the taste of a childhood treat; memories come flooding back, and his aunt Léonie's house rises "up like a stage set" (Proust, 1913|1992). However, the bookish child of this account sails through school and his experience of formal learning is not examined.

The idea here is that in works of literary fiction, the novelist has understood something of the human condition, and is able to express something of the essential nature of human experience through the medium of his or her characters. Nussbaum is not the only philosopher to recognise this. The philosopher novelist Irish Murdoch who, according to George Steiner (1999, p. xvi) "[was] *certain that, in the final analysis, it is the novelist who is the greatest truth teller*", claimed that "*great art is able to display and discuss the central area of our reality, our actual consciousness, in a more exact way than science or even philosophy can*" (Murdoch, 1999, p. 240).

The idea that the novel can be used to understand subjective human experience is given further support by the early history of Psychology. Wilhelm Wundt is generally

considered to have founded scientific Psychology with the first empirical work on the mind in the mid nineteenth century but, as Teo (2017) reports, Wundt felt that both empirical science and the humanities should be represented in the field in order to draw on the "long tradition of research on the processes and products of human mental life" that belongs to the humanities (Teo, 2017, p. 281). There is, then, both intellectual justification, and a respectable tradition of using the novel, and other works of Art, to understand first-person experience. In the absence of a body of empirical work on what it means to be a learning human, perhaps literature may be used to determine whether the student experiences reported here are idiosyncratic (or at best, highly context dependent), or whether they represent of a more general truth about human experience.

Novels about schools and learning tend to focus on grand themes rather than the "sheer ordinariness" of interest-excitement in learning, and experiences of learning in literature are more usually framed around issues of social mobility, such as Thomas Hardy's "Jude the Obscure"; or descriptions of deprivation or depravity - the awful Mr Wackford Squeers in Dickens' "Nicholas Nickleby" being an example of the latter. However, descriptions of interest-excitement in learning that are activated by the presence of others, or by physical environments, can occasionally be found in stories, strewn between more salient life events. In the following section, I will use extracts from two well-known works of fiction to support the central claim of this thesis - that three dimensional environments and the real presence of others activate interest-excitement via perceptual curiosity.

The Rainbow

DH Lawrence's "The Rainbow" follows the lives and loves of several generations of a Nottinghamshire farming family, the Brangwens, in particular Ursula Brangwen's journey of self-discovery at the turn of the nineteenth century. Ursula's grandfather Tom was sent unwillingly to grammar school by his determined mother where, as he had anticipated, he "cut a sorry figure." He finds book learning difficult and has to "beat down his first repulsion" in order to try to concentrate:

"But he loved anyone who could convey enlightenment to him through feeling. He sat betrayed with emotion when the teacher of literature read, in a moving fashion, Tennyson's "Ulysses", or Shelley's "Ode to the West Wind." His lips parted, his eyes filled with a strained, almost suffering light. And the teacher read on, fired by his power over the boy. Tom Brangwen was moved by this experience beyond all calculation, he almost dreaded it, it was so deep. But when, almost secretly and shamefully, he came to take the book himself, and began the words "Oh wild west wind, thou breath of Autumn's being", the very fact of the print caused a prickly sensation of repulsion to go over his skin, the blood came to his face, his heart filled with a bursting passion of rage and incompetence. He threw the book down and walked over it and went out to the cricket field." (p10-11)

Tom needs the teacher to "convey enlightenment through feeling". The central question of perceptual-curiosity, introduced in Chapter 3, is "what is this and what does it mean for me"? In Tom's case, the feeling in the poem needs to be communicated to him through another person, something that may be mediated by an intermediate question "what is this and what does it mean for that person?" This idea resonates with some of the students' comments about enjoying learning with others, in particular talking about lectures after class, reassuring each other about "awful" lectures, and a student's joking comment that if he/she saw others writing something down, (s)he knew it must be important. The very physical "prickly sensation of repulsion" is not only consistent with ideas of the embodied mind, but is a sensation that may be familiar to some students

when engaging with digital media and is certainly consistent with strongly expressed views about "HATE[ing]" digital lectures. I certainly recognised the passion of "rage and incompetence" as something that I experience regularly when I have to engage with electronic patient records during clinical encounters.

Tom Brangwen's stepdaughter Anna, has a similar experience of socially mediated interest-excitement. A step cousin, Will, who is interested in church architecture comes for Sunday lunch and speaks about his passion:

"Listening to him as he spoke of church after church, of nave and chancel and transept, of rood-screen and font, of hatchet-carving and moulding and tracery, speaking always with a close passion of particular things, particular places, there gathered in her heart a pregnant hush of churches, a mystery, a ponderous significance of bowed stone, a dim coloured light through which something took place obscurely, passing into darkness: a high, delighted framework of the mystic screen, and beyond, in the furthest beyond, the altar. It was a very real experience…(p108)
…A flame kindled round him, making his experience passionate and glowing, burningly real" (p109)

Anna feels that "*the bounds of her experience [are] transgressed*" after this discussion and, while it is not clear how much this refers to an interest in church architecture and how much to an interest in the young man, there is again the idea that knowledge becomes meaningful to us when we can see its importance to others, and that this is something that is communicated by a real personal presence. It is difficult to imagine a "flame kindled round" a person imparting knowledge via digital media and, again, this has echoes of the students' comments about it being really "*jarring*" to learn from "*a tiny square of human being*." It is a notion that also adds depth to the idea of social learning, which is usually interpreted as a prescription for instructional designs that encourage

students to work co-operatively. Instead, social learning can be viewed as the activation of curiosity about others and the resultant affective response: “What is this, what does it mean for that person and therefore what does it mean for me?” It is difficult to find answers to those questions when social contact is limited to a *“tiny square of human being.”* .

We can also find evidence supporting the claim that physical environments are important for learning. Will and Anna marry. It is not a particularly happy marriage but they have a daughter, Ursula, whose young life and loves are the focus of the rest of the book. Ursula enjoys learning. She finishes school and, after a trying period as a teacher, she enters the local college. She recognises, from her father, that the college’s architecture is “*foolish*”, but she also recognises the cloistral origins of the college and the knowledge that seems to permeate its walls:

“Here, within the great, whispering seashell, that whispered all the while with reminiscence of all the centuries, time faded away, and the echo of knowledge filled the timeless silence.

“She listened, she scribbled her notes with joy, almost with ecstasy, never for a moment criticising what she heard. The lecturer was a mouth-piece, a priest. As he stood, black gowned on the rostrum, some strands of the whispering confusion of knowledge that filled the whole place seemed to be singled out and woven together by him, till they became a lecture.” (p431)

The idea here is that some physical environments bestow a legitimacy on the learning that takes place there. Ursula feels connected to historical, centuries-old learning, that causes her to scribble her notes “*with joy*, ” something that reflects the students’ comments that recognised learning spaces, such as libraries, are “*conducive to good*

learning." Perception-curiosity finds meaning in physical environments by asking the question: "what is this place and what does it mean for me?"

The prime of Miss Jean Brodie

Notions of meaning in physical learning environments can also be identified in a rather different novel, Muriel Spark's "The Prime of Miss Jean Brodie" (Spark, 1965). In this book, a charismatic school teacher in her prime nurtures the ideals of glamour and romance in a group of schoolgirls with unexpected results. Spark describes an affect-laden discovery of meaning in a physical classroom environment when an eleven year old Sandy is sent to the Senior School's science room to have ink swabbed from her tussore blouse by the thrilling Miss Lockhart:

"Sandy stood enthralled by the long room which was this science teacher's rightful place, and by the lawful glamour of everything there" (p25)

The science room, with its strange smells, and interesting senior girls, is responsible for much of Miss Lockhart's charm, and she loses something of her quality when Sandy sees her *"walking from the school in her box-pleat tweeds like an ordinary teacher"* (p24).

Unfortunately, not all classrooms possess lawful glamour, and when they do not, they can be associated with other affect-laden experiences that determine engagement. The Brodie set has a rather different reaction to the art room, where they are taught by the one-armed Teddy Lloyd:

"The girls immediately felt the relaxing nature of the art room, and brimmed over with relaxation. Mr Lloyd shouted at them in his hoarse voice to shut up. This was most bracing." (p79)

Spark does not offer descriptions of learning that is given meaning by others in this book, although Miss Lockhart, like Will Brangwen, is described as having an aura and seems "*to carry six inches of pure air around her person*" (p24). However, she does describe how we judge the value of ideas and attitudes according to who embodies them. When the Brodie set moves to the secondary school, the headmistress distributes them to different houses, in the hope that they may adopt different identities. Unfortunately for her, efforts to instil the Team Spirit into the girls fails because:

"Not one of the senior house prefects personified an argument that could touch Sybil Thorndyke or Cleopatra." (p79)

Far from competing with each other in the classroom and on the hockey field, the girls stay bound together by the values of glamour, love and individualism that have been instilled in them by their charismatic teacher. Perhaps personal influences of this type can be framed as a perception-curiosity question: "who is this person and what do they mean to me?" This idea resonate with the students' statements about the importance of the real presence of other humans, which made things *"so much more interesting and engaging"*.

In both "The Rainbow" and "The Prime of Miss Jean Brodie", we find evidence of the multi-sensory nature of learning. In particular, the metaphorical use of the idea of smell

when describing exciting knowledge. Ursula Brangwen wins a place at the Grammar School where she is joyful about the prospect of new knowledge:

"There was always the marvellous eagerness of in her heart, to climb and see beyond. A Latin verb was virgin soil to her: she sniffed a new odour in it; it meant something, though she did not know what it meant" (p267)

And a young Brodie set experiences *"the exhilarating feeling of being in on the first smell of a row"* (p10) when Miss Jean Brodie criticises a poster of Stanley Baldwin that has been placed by the headmistress. The metaphorical use of smell to describe the acquisition of interesting-exciting knowledge in these two passages supports the notion that it is an embodied experience that takes place in a real environment, not simply the transfer of information in the most efficient way possible. Smell was a phenomenon used by students to describe books. P019 stated *"I love the smell of textbooks"* , while P005 had a different view of textbooks: *"you know, they have such a cloying smell."*

Of course, both of these books were written long before digital learning was possible, but the rich descriptions of human experience in "The Rainbow" and "The Prime of Miss Jean Brodie" mirror some of the comments made by the students about digital learning and reported in previous chapters. They can be framed as questions for perceptual curiosity, such as:

"What is this place and what does it mean to me?"

"What is this and what does it mean to that person?"

"What does that person mean to me?"

These are questions that will be revisited in the following chapter, in which Tomkins' ideas will be extended to suggest a theory of learning engagement that accommodates the perceptual experience.

11. Extending Tomkins: towards a theory of learning engagement

Tomkins recognises the importance of the perceptual experience, describing humans as "incurably" visually minded and favouring "extended spatial entities that endure in time" (S. S. Tomkins, 2008b, p. 992), a view that converges with the notion of the actively perceiving, curious embodied mind described in Chapter 3. If, as I suggest in the previous two chapters, a sustaining interest in learning materials is reduced by an impoverished perceptual experience, then fatigue and the anomie to which "cognitive competence is peculiarly vulnerable" (S. S. Tomkins, 2008e, p. 188) seems a likely result. In this chapter, I will suggest a mechanism by which the reduction of the perceptual experience to a blue-lit 2 dimensional screen may reduce interest-excitement and result in anomie – or a feeling of disconnection, discomfort and fatigue by drawing on, but extending, Tomkins' theories.

Tomkins recognises the affective qualities of perception and their importance in learning

Tomkins describes the relationship between perception and the affect of interest-excitement. This motivating affect, he argues, "lends its magic to support sensory input.. memory.. thought and.. action," and in the absence of interest "acquaintance with objects would be grossly impoverished with the further consequences of lack of commitment to the world and lack of development of general competence". He also notes that "cognitive competence [is] peculiarly vulnerable to anomie" when a

"sustaining interest" is absent (S. S. Tomkins, 2008e, p. 188). However, Tomkins does not explain the necessary conditions for interest-excitement to be attached to cognitive activities or to perceptual experience, and these conditions need to be established if Tomkins' theory is to be used to explain why excitement-interest is diminished in some particular contexts of perceptual impoverishment, such as screen-based learning.

Drive-Affect pairs

Tomkins' describes the pairing of affects and drives. Drives such as hunger and the anoxic drive are recognised as phenomenally distinct from affective responses like rage and love in most cultures (Nussbaum, 2001b); Tomkins describes drives as systems that provide specific, motivating information "of *time*, of *place* and of *response—where* and *when* to do *what*" (S. S. Tomkins, 2008c, p. 17). For Tomkins, drives result in conscious reporting of biological or survival needs but they are not, in themselves, motivating. Motivation, which Tomkins (2008c) understands as "a feedback report of a response" that governs seeking, avoidance and maintenance behaviours, is provided by the concurrent and much less specific affective response that is attached to the drive.

Tomkins (2008c) discusses several drive-affect combinations: the affect of fear that motivates the drive for air in asphyxiation; distress that makes hunger more urgent; and the interest-excitement associated with the sex drive but, while he recognises that curiosity is a pre-requisite for interest-excitement in cognitive work (S. S. Tomkins, 2008e), he does not recognise curiosity as a drive, rather using the term synonymously with "interest" in places (S. S. Tomkins, 2008d). A similar merging of curiosity and affective response is offered by Panksepp, one of the pioneers of affective neuroscience,

who describes the “basic emotional and motivational process” of SEEKING (Panksepp, 1998). However, curiosity meets Tomkins’ identity conditions for a drive because it is a biological imperative that provides motivating information about a specific context.

Curiosity and interest-excitement as a drive-affect pairing in learning

If curiosity is a drive, which affects is it paired with? It seems likely that the type of affective response that becomes attached to the curiosity drive must, to some extent, depend on what curiosity achieves: if curiosity about a rustling noise drives exploration of a physical environment and a cobra in strike posture is perceived, this might result in fear that motivates avoidance. In intellectual work, the relevant affect is interest-excitement, the affect that biases us “toward novelty and mastery” (S. S. Tomkins, 2008c). When we are confronted with information that provides solutions to questions that are important to us, we experience a positive affective response, something that Bain describes as: “the pleasure of *rebound*, the lightening of an intellectual burden, or the solving of a difficulty that formerly weighed on the mind” (Bain, 1865), and contrasts this with “contrary statements [that] operate on the mind as a painful jar, and stimulate a corresponding desire for reconciliation”(Bain, 1865). Although Bain was referring to intellectual rather than perceptual curiosity, similar affective responses might be expected from the satisfaction or frustration of perceptual curiosity, given that perceptual curiosity is so deeply embedded in our phylogeny.

Making a distinction between curiosity understood as a drive that impels the collection and use of information, and the affective response to curiosity’s findings, is useful

because it provides a more precise analytical framework. Examining curiosity and interest-excitement during learning as a drive-affect pairing means that questions can be asked about what sort of things we are curious about, and about how drive (dis)satisfaction might promote an affective response. Curiosity becomes the missing link between perceptual experience and affective response.

Towards a theory of learning engagement? The relationship between perception, curiosity and affect

A theoretical definition of learning engagement that could explain why perceptually impoverished environments are experienced as uninteresting and therefore fatiguing starts to emerge from this discussion of the interplay between perception, curiosity and interest-excitement. Drawing on the arguments about perceptual curiosity made here, and the embodied nature of the learning mind made in Chapter 3; Tomkins' ideas about the motivational properties of affects and the importance of interest-excitement for sustained work can be extended by making the following statements:

1. Perception, defined as the process of collecting information about the world, is an act of attention (Gibson, 1979).
2. Curiosity is a biological imperative that provides motivating information and it therefore meets Tomkins' identity conditions for a drive.
3. Curiosity about percepts is a pre-requisite for learning. This has been formally shown to be the case if Bayesian models of learning are used (Friston et al., 2017)

4. If information in the percept can be used to infer how preferred outcomes can be achieved, there is drive-satisfaction of curiosity. This follows from the drive-affect pairing of curiosity and interest-excitement that can be derived from Tomkins' theory.
5. Drive satisfaction of curiosity is associated with the positive affect of interest-excitement. Bain's descriptions of the different affective responses to satisfaction and dissatisfaction of curiosity are easily recognisable.
6. Interest-excitement provides positive motivational feedback that leads to sustained attention. Tomkins claims that interest-excitement is an orientation affect that "enables the individual to sustain attention to complex objects" (S. S. Tomkins, 2008e, p. 186).

These statements can be summarised as the perception-curiosity-interest/excitement loop shown in Figure 11.1.

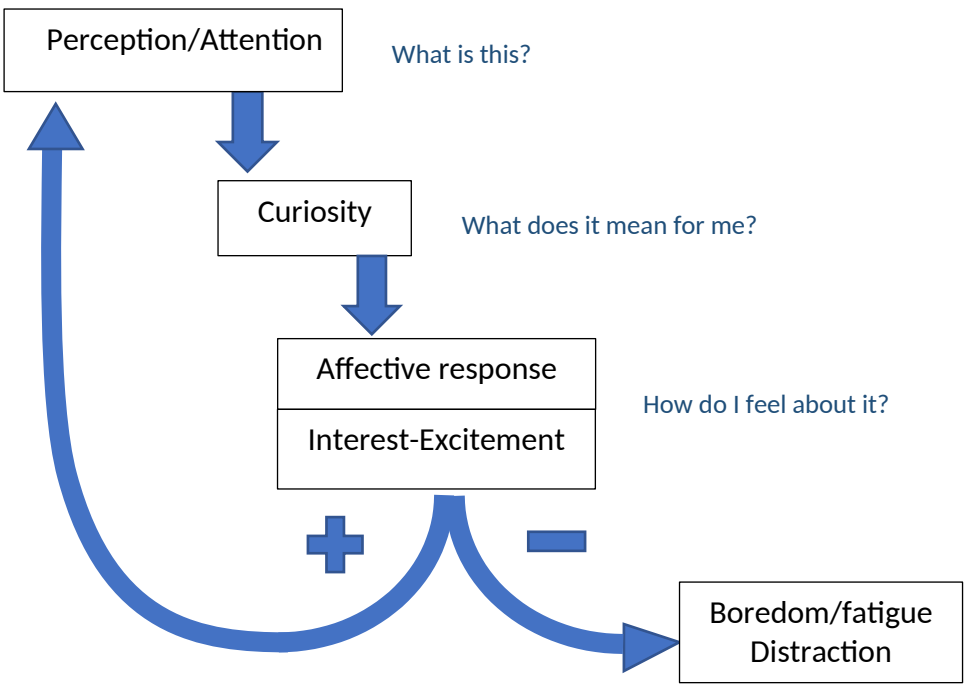

Figure 11.1: Theoretical definition of learning engagement derived from Tomkins' Affect Theory

The claim made here is that there is a positive feedback loop, with the motivational gain from curiosity-driven interest-excitement promoting sustained attention. That is not to say that attention will be directed to the same piece of information in an endless loop, but that curiosity will direct attention towards percepts of that kind.

While this explanation matches our intuitions about learning that satisfies intellectual curiosity, it is not a particularly productive theory used in this way: it predicts that attention will be fostered by interest-excitement that, in turn, is generated by learning content that resolves learning questions that are important to an individual. This is hardly new knowledge that can be used to better inform learning design, and it also does not offer an explanation of the empirical work I have presented here, which indicates that students link difficulty in sustaining attention to digital media with an impoverished perceptual experience; in other words, that three dimensional environments and the presence of real others – particularly instructors – contribute to sense-making, interest-excitement and attention.

A useful theory would go beyond an explanation of how the positive affective response to satisfaction of intellectual curiosity motivates learning, and would explain how drive satisfaction of *perceptual* curiosity in real, three dimensional learning environments generates interest-excitement and attention. The empirical work reported earlier,

supported by the literary texts in Chapter 10, suggest that the learning human seeks meaning in places and in others, perhaps asking the perceptual curiosity questions:

“What is this place and what does it mean to me?”

“What is this and what does it mean to that person?”

“What does that person mean to me?”

Figure 11.2 indicates how the perception/attention, curiosity, interest-excitement loop in Figure 11.1 can be extended to accommodate questions about place and person that are derived from perceptual curiosity:

Several of the students' comments reported earlier support the idea that the meanings of plac[illegible] from [illegible] ce environments differed, and that th[illegible] influenced [illegible]th how they [illegible]ng, and their learning behaviour. Figure [illegible].3 shows so[illegible] data that is reported in the Results chapters, but differen[illegible]ly organised, so that it [illegible]m [illegible] Figure 11.2. These comme[illegible]ts support the cl[illegible] the sense of meaning provided by three-dimensi[illegible]nal places whos[illegible]at meanings derived from the presence of others i[illegible]missing when th[illegible]comm[illegible]icat[illegible]line; that for several students this is associated with [illegible]negative aff[illegible]tive respon[illegible] and that [illegible]ty sustaining attention.

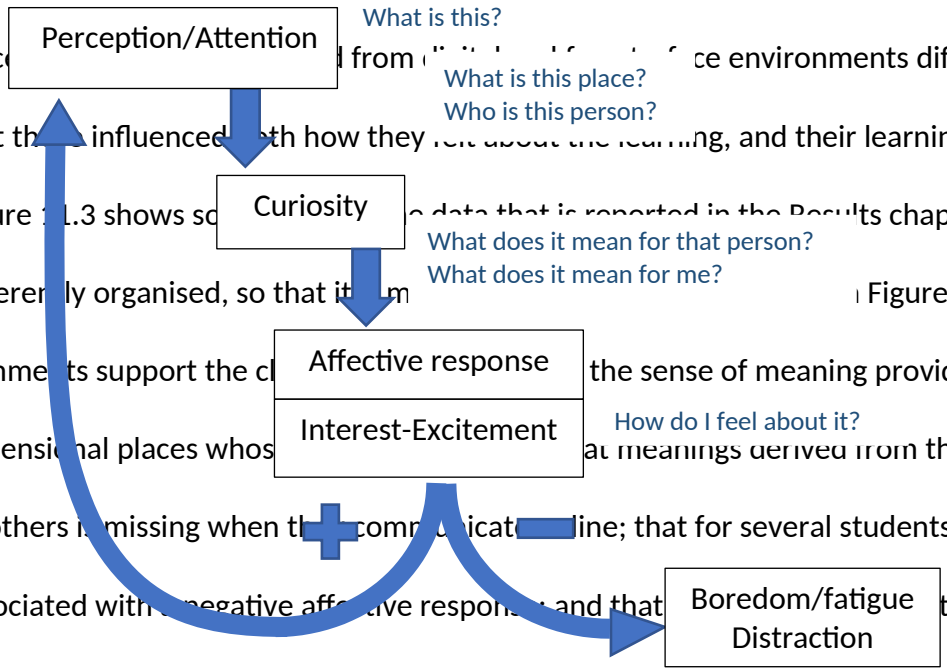

Figure 11.2: Perception-Curiosity-Affective response applied to perceptual curiosity

Figure 11.3: Students' comments about digital and face-to-face discussions mapped onto the proposed model. (Orange= Comments about digital lectures and tutorials; Green = Comments about face-to-face lectures and tutorials)

Meanings of Place

For students, digital learning often takes place in shared accommodation or in the parental home and these are not places that bestow particular legitimacy on learning. Students talked about the difficulty of “blurring” home and work environments, and the tendency to have coffee with housemates instead of studying – a completely reasonable action in a place whose meaning is relaxation. Some students searched for meanings of place in the digital environment but indicated that they were not able to “feel the room” and had “no palpable understanding of an atmosphere” in the digital classroom. The question “what is this place and what does it mean to me?” implies that, for some people at least, it is inherently more difficult to sustain attention to screen-based learning that takes place in a non-learning environment. It also provides a plausible explanation about why students starting a course may initially choose a seat at random, but will continue to migrate to the same place in subsequent lessons, and why reading and writing in an ancient library is so enjoyable.

Meanings of person

The question of whether it is possible for a teacher or co-learner to convey equivalent meaning and interest-excitement via digitally mediated and face-to-face teaching is less clear, although several of the students I interviewed disliked not being able to derive meanings from the “tiny square of human being” on their screens, and they talked about “brick walls” between them and the digital teacher, and not being able to “read” their faces, and there was a strong sense that the students did not feel a sense of connection with lecturers or fellow students during digital teaching. Bain claims that we have an involuntary disposition to take on the embodied emotions of others (Bain, 1865), a claim

that resonates strongly with experience - the highly infectious nature of inappropriate giggling vividly described by Spark (p49) being one example. Bain's claim about the involuntary nature of this empathetic response received some support in the 1990s with the discovery of "mirror neurones", located in the pre-motor area of the simian brain that show the same patterns of activation when an experimental subject performs an action and when it is observed in another (Gallese et al., 1996), demonstrating a neural correlate of empathy that has stimulated great interest.

There was a strong sense in the interviews that students did not feel a sense of connection with lecturers or fellow students during digital teaching, but is a real three-dimensional presence necessary in order to *feel* the meaning of ideas communicated by others? Do we need a real three-dimensional presence to *feel* what somebody else means to us? The answer to that is less clear - a direct personal experience of leaders like Nelson Mandela and Queen Elizabeth II was not necessary for many people to feel a sense of connection with them and to derive affect-laden meaning from their lives. Involuntary facial movements and mirror neurone activity have also been demonstrated in human experimental subjects exposed to the facial expressions of anthropomorphic virtual characters (Schilbach et al., 2008), but it is far from clear that human responses to digital avatars result in the same first-person experience as the response to another real person's facial expressions experienced in a face-to-face setting.

Tee examined the creation and maintenance of online charisma, using a creationist religious leader as a case study. She notes that charisma in her case study was successfully constructed using social media, but that these activities were "crucially

supported" by real world activities, such as creation-themed parks that attracted large numbers of visitors (Tee, 2019), suggesting that digital presence alone is not enough to sustain a followership. This is consistent with historical evidence of charismatic leaders supporting their mediated presences by real presences; the Nazis' Nuremberg rallies in an era when political messages could be delivered more efficiently by radio offering an extreme example. It seems then that human communication that is mediated, rather than direct, may be less meaningful to those receiving it: the perception-curiosity questions "what is this and what does it mean to that person?" and "what does that person mean to me?" are more likely to be asked and answered in a way that activates interest-excitement in face-to-face encounters.

Curiosity and the role of imagination

It would be an oversimplification to conclude that, in screen-based learning, perceptual curiosity is unexcited because there is less sensory information and therefore less to be curious about. This explanation would predict that listening to the radio would inevitably lead to boredom and distraction; the blind and the deaf would have little interest in the world around them; and nobody would use talking books. None of this is true. The concept missing from this treatment is imagination, in which some media stimulate the imagination, which produces rich mental images and representations in the same way that story telling does. These are things we can be curious about and derive meaning from. It is more likely that two-dimensional digital media provide enough sensory information to nullify imagination without giving us anything that our perceptual curiosity can work on. Neither imagination nor perceptual curiosity is recruited, and students are

instead asked to focus attention on what one of them described as "*a tiny square of a human being…[with]…no like palpable understanding of like, an atmosphere*." These types of experiences may represent true perceptual poverty, rather than media that use one sense only, because they give little to the senses while leaving nothing for the imagination.

Implications for socio-materiality

Socio-material theories of human-computer interaction, such as Actor Network Theory are widely used. The central idea is that devices and humans interact with each other in symmetrical ways, and investigators using this framework are careful not to privilege human over non-human actors. The theorisation of learning engagement I present here challenges that notion. Humans require an affective response in order to make the inferences derived from curiosity meaningful and to provide motivating feedback. If we accept the argument that the mind is embodied and that affective responses are therefore the first person experiences of physiological changes (see Chapter 3), it follows that technologies are unable to experience affects in the same way because they lack the necessary tissues: curiosity may be programmed into robots but they cannot feel as we do. They cannot therefore be inspired by others any more than they can be bored. I argue that technological devices are tools, like toasters and lawnmowers, and that theorising symmetrical relationships between humans and computers is unlikely to generate useful knowledge.

Digital learning: Efficient but de-humanising

The empirical work presented earlier suggested that, while students appreciate the convenience and safety of digital learning, they do not actually enjoy it. One student said that the problem with digital learning is that you "miss the little things that make you human", which raised a question about what those "little things" are and what effect their absence might have on learning engagement. When the empirical findings reported earlier are interpreted within an ontological framework that presents the learning mind as driven by curiosity and susceptible to the motivating affect of interest-excitement, the conclusion is that students never can feel the same way about two-dimensional screen based learning as they do about face-to-face learning. We have evolved as creatures with perceptual curiosity and look for meaning in places and others, it is just the way we are made. Screen-based learning is inherently perceptually uninteresting: it does not satisfy our perceptual curiosity about places and people, even lacking the meanings found in three dimensional books with their tactile qualities and histories that the students referred to, and it leaves nothing for our imagination. Without the interest generated by perceptual curiosity, we experience fatigue.

Strengths and limitations

Repertory grid methodology provided challenges, but also several benefits. The triadic elicitation method was found to be a useful tool for probing how students evaluated different media and even if practical constructs such as "live versus recorded" were initially volunteered, the laddering method, in which students were asked which pole they preferred and why, almost always produced interesting discriminating

characteristics. In this way, the topics of discussion more likely represented the issues of importance to the student than would have been the case in a standard qualitative interview. I had undertaken several individual and focus group interviews during the design research that is reported in Appendix B, and I was struck by how much harder students had to think, and how much more profound were their comments, when they were asked to identify constructions and to offer a reasoning for their preferred poles, than when they were asked about their learning-design preferences,

The probing nature of a grid interview brings its own challenges, though. Students often had to think quite hard, particularly about the opposite pole of a construct and sometimes found it difficult to articulate their ideas. In this situation, it was difficult to avoid suggesting words that might have summed up what the student was saying, with the attendant risk of providing construct poles for them. A second threat to validity is found in the interpretation of texts and the selection of illustrative quotations. Text segments that capture exactly how the interviewer is thinking about a topic will always appear worthy of inclusion as quotations, regardless of how well they reflect the shared thinking of the group of interest. For this reason, the parallel use of biplots offers a useful counterbalance to the qualitative analysis, by summarising all students' ratings of elements against their own constructs within a theme. Of course, the development of themes required some interpretation, but the use of a "best fit" framework as a starting point at least provides some transparency for this part of the analysis.

A particular weakness of this study was the lack of data on individual participants. I deliberately did not collect demographic data on the students because, in a fairly small

class, this may have made the contributions of individual students identifiable. It might have been interesting to compare constructions based on, for example, gender as Atieno (2023), did but I had no *a priori* reason to think that the constructions of different population groups would differ. Inferring the shared construing of groups is permitted by Kelly's Commonality Corollary, which states that "to the extent that one person employs a construction of experience which is similar to that employed by another, his processes are psychologically similar to those of the other person"(Fransella et al., 2004a, p. 10) but, given the personal nature of a grid, how similar do participants need to be in order to assume shared construing?

In this study, I chose to consider clinical medical students who had experienced an unexpected substitution of face-to-face teaching by digital teaching in one university as a single group. There were some individual characteristics that I felt offered important insights, such as the value of recorded sessions for a dyslexic student, and the perspective brought by a mature student who took a first professional degree before digital teaching was common, and was able to highlight the loss of camaraderie, and the potentially "horrendous" pressure placed on less secure students by the volume of available digital learning, but it is possible that there were differently construing sub-groups in the sample that I did not identify. A generalised Procrustes analysis (Grice & Assad, 2009) might have identified these, but Procrustes analysis has its own limitations that were discussed in Chapter 5, and this would have involved a rather different research plan.

It is important to note that the repertory grids and interview data reported here claim only to represent the shared construing of a group of full time clinical students training in

the same programme. Other groups may construct digital learning differently. For example, part time students who have already spent a day in three dimensional, real time interactions with other people may differently construct an evening learning environment that is isolated and perceptually impoverished, perhaps finding it relaxing. Alternatively, students living in areas with poor digital infrastructure may have constructions that are dominated by frustrations about technical problems. Honey's method (see p.71 Methodology) could usefully be used to compare the constructions of different user groups: by supplying a construct of "Low value to High value", the elicited constructions most closely related to this construct could be identified and compared. This may be a productive direction for future research.

The students in this study were selected by convenience; that is, they happened to be present in the Surgical Emergency Unit at the time I was recruiting participants, on a day when I was also physically present. They may therefore not represent the clinical medical student cohort as a whole and it is, in theory, possible that this was a selected group of students that valued face-to-face teaching, with another group of students who preferred digital teaching concurrently learning online in a different environment. It is difficult to answer this challenge without a formal attendance register but we were certainly not aware of absenteeism, the problem was rather one of making space for allocated students in the available clinical teaching opportunities.

Another potential criticism of this research is the lack of detail about the digital teaching the participants had actually received. The pivot to digital teaching during Covid-19 "lockdowns" was necessarily rapid, and it forced a somewhat makeshift substitute

curriculum that was dominated by recorded digital material and videoconferencing, rather than a planned one. It could be pointed out that students' construing about these well established technologies may not represent construing about digital learning in general, but the students' comments about teaching being "so much more engaging and interesting" when there is a real person in front of you, and the influence on engagement of the purpose of the place where you study, are relevant to digital learning in general. My argument is that the medium itself influences how students think and feel about learning in digital and face-to-face environments.

It is important to examine the external validity of these findings. Oxford medical students are probably not typical higher education students. The competitive nature of admission and the demands of the course indicate that these participants are likely to be highly effective learners, and the transcripts also showed strong indications of reflective learning. They therefore probably represent an outlying group in the population of higher education students, but this is something that can be used to advantage. Outlying cases can help to build theory, for example by identifying boundary conditions (Gibbert et al., 2020). Examining the experiences of a group of students with a track record of effective studying means that any difficulties in engaging with online learning should not be attributed to their lack of academic commitment or ineffective study skills.

Finally, another issue of external validity is not so easily dismissed. The value placed by the students in face-to-face learning was strongly influenced by the tutorial system in Oxford, where they have regular, very small group discussions with a tutor. These were valued as opportunities to explore topics, push the boundaries of their knowledge, and

ask questions in a relatively safe environment. Being a tutor in an Oxford College is considered an honour, rather than something that experienced clinicians do for financial gain, and this gives Oxford access to a large group of candidate tutors. Of course, clinicians give freely of their time to teach students in many parts of the world and have done so for decades, but the ratio of Oxford tutors to students and the regularity with which they are able to meet would be difficult to replicate elsewhere.

12. Implications for digital instructional design in medical education: The Efficient and the Human

In the previous chapter I presented a theory of learning engagement, building on Tomkins' work by using more recent neuro-philosophical ideas about curiosity and perception. This theory suggests that a lack of perceptual interest-excitement is inherent in two dimensional digital learning and that, because two dimensional digital learning provides impoverished meanings of place and person, it cannot be made as interesting or exciting as face-to-face learning. If that is the case, instructional designers might do well to make peace with this, creating digital classrooms that follow established pedagogical principles, and maximising the efficiency gains of digital teaching, while continuing to value the affordances of face-to-face learning. In this chapter I explore how this can be done, and what it means for medical education more broadly.

Getting the most out of efficient learning media

The nature of screen-based learning may fix perceptual interest-excitement at a fairly low level, but this is not true of intellectual curiosity. Perhaps the perceptual poverty of screen-based learning can, to some extent, be compensated for by designing content that engages attention by optimising the appeal to intellectual curiosity. This means that content should be very carefully curated, and that what one student referred to as a "brain dump" should be avoided. At the same time, provision must be made for screen fatigue. There is empirical work indicating that the optimal length of recorded videos is

somewhere between 6-14 minutes (Guo et al., 2014)(Hamid & Samad, 2015), and that asynchronous content should be segmented accordingly. There is also some indication that students find videos that show a "talking head" more engaging than static slides (Guo et al., 2014). Both of these empirical studies examined how long students played recorded videos, a method not appropriate for examining the duration of students' attention to synchronous digital instruction. However, while there is less data about engagement with live sessions, the data in this thesis suggests that engagement problems are related to the nature of the digital medium rather than whether content is recorded or live, and it seems equally prudent to incorporate regular breaks into live digital sessions, and to include a video inset during slide presentations. The easy distractibility of students using digital learning reported in this work, also suggests that instructors should pay attention to distractions such as background noise and interruptions when they are delivering digital content. The quality of the user interface and technical support for learning management systems also make a significant contribution to the learner's experience (Al-Fraihat et al., 2020)

Many of the students I interviewed wanted interactivity in digital learning spaces, a finding supported by other authors (Bashir et al., 2021). However, students' demands for more interactivity when online seems to be in conflict with a reluctance to interact during digital learning; for example, many educators report minimal use of discussion forums in digital classrooms (Lwoga, 2014; Morrison, 2012; Nandi et al., 2011), and about half of university students feel uncomfortable having their cameras on during online classes (Asgari et al., 2021; Bashir et al., 2021). Several of the students I interviewed also indicated that they did not use the chatbox function to ask or answer questions because

they worried about exposing their knowledge gaps. When asked about game-based learning during the repertory grid phase of this study, most students had not tried it, but thought it sounded “gimmicky”, and other authors have suggested that game-based learning is a little like “chocolate covered broccoli” in that it combines two objects that are better kept separated and enjoyed for their individual merits (D’Mello, 2021). So what do students actually mean when they request interactivity? It is clearly not a demand for more digitally mediated discussions and tricksy activities. It is possible that students wishing for more interactivity are just expressing their sense of anomie and disconnection when learning online, or their desire for breaks at regular intervals, but it can also be interpreted as support for the use of tools that have been shown to improve attention and/or learning. These include activities such as short quizzes and polls, which may add to the efficiency of learning by providing immediate feedback, allowing the student to check his or her own knowledge, and focussing the student’s attention on important concepts (Gamage et al., 2019). All this indicates that the use of reliable pedagogy is more likely to engage than an effort to make things “fun”, or to attempt to overcome the feeling of disconnection that is a consequence of fixed perceptual characteristics.

An efficient approach to teaching and learning may appeal more to some learner groups than others. Continuing professional development is an imperative for healthcare professionals because it is a field where knowledge changes rapidly (Karas et al., 2020), but it needs to be tailored to the learning gaps and needs of individual clinicians (Bennett et al., 2000; Norman et al., 2004) . At the same time, health professionals are limited in the time they have available and geography may limit their access to centres of learning. The flexibility of time, place and content that is offered by digital learning is likely to be

particularly valuable to groups like this, and these attributes may outweigh any affect-driven discontent with the digital medium. That may be particularly the case in learners who have spent most of their working day dealing with real colleagues and real patients in the "analogue world" and who might, like one of the students in my study, actually enjoy an undemanding, "perceptually quiet" interaction with a computer screen at the end of the day. While the same arguments could be applied to medical students, I believe that the priorities are different and that the chosen learning medium may have an impact on the types of doctors that we train.

The enduring value of human learning approaches in medical education

As I indicated in the introduction to this work, medical education has been the subject of repeated calls for reform in response to global dissatisfaction with health systems and persistent health inequalities (for example, Frenk et al., 2010). Although several of these concerns, such as a need to widen access to medical training, have been recycled and voiced as new and urgent at regular intervals over the past 100 years (Whitehead, C.R et al., 2013), a particular concern in contemporary medical education is a claim that the "empathy and moral development" of medical students tends to become "stunted" as they move through the curriculum (Pedersen, 2010). In response to this, many curricula have now incorporated classes in medical humanities, which are intended to train the imagination in order to appreciate the perspectives of others (for example, V. J. Grant, 2002) and which, as Downie (2003) points out, are informed by the assumption that the exposure to the humanities can make a doctor more "humane", an idea categorically

rejected by George Steiner, who pointed out: “We know now that a man can read Goethe or Rilke in the evening, that he can play Bach and Schubert, and go to his day's work at Auschwitz in the morning.” (Steiner, 1986, p. ix).

I am not convinced by the claim that doctors undergo a problematic moral stunting during their training. This is partly because I am old enough to have been told that a little professional distance is a healthy thing for a doctor who wishes to survive long term in the profession, and that patients do not want you to grieve for them but to help them; it is also, in part, because I do not notice a moral deficit when I compare the characters of friends and colleagues in and out of the profession. The claim that doctors do not read novels, play music or appreciate art is also unsupported. However, I certainly do accept the proposition that we do not wish to train de-humanised doctors who are unable to communicate with their patients or their colleagues, and who are unaware that others may have different but valid perspectives.

The students in the interviews I have reported here were very clear that face-to-face encounters gave them the opportunity to “read” the faces of others, and allowed calibration of the pace of discussion pace and difficulty of content. They also reported a feeling of connection to the patients they saw, which activated more profound learning and they noticed the reactions of their colleagues, perhaps offering a “reassuring pat on the shoulder” [P020] after a particularly opaque lecture. These very human, social and empathetic responses seem to be fostered in a face-to-face learning environment which, as I argue in the previous chapter, is rich in meanings of place and person for the learning human. I have also argued that some of the students I interviewed experienced digital

education as dehumanising and, if these arguments are accepted, it suggests that the widespread replacement of face-to-face activities in medical curricula by digital media could pose a far greater risk of training “morally stunted” doctors than the risk posed by traditional curricula. If we wish to train emotionally competent doctors, we should not over-expose them to potentially dehumanising learning media, but continue to value face-to-face encounters and aim for a thoughtful balance of the efficient and the human in medical education.

13. Conclusions and contributions

This thesis started with an intent to design engaging materials for digital clinical teaching, but it ended with the slightly nihilistic conclusion that the perceptual qualities of two dimensional digital media make it inherently less interesting than face-to-face learning, something that is experienced as fatigue and easy distraction. When we are asked to engage with a two dimensional digital screen, we miss “the little things that make you human”. Those “little things” are the meanings we derive from places and people that are generated by perceptual curiosity questions such as: “what is this place, what does it mean to me?”; “who is that person and what do they mean to me?”; “what is this and what does it mean to that person?”.

Digital learning is efficient but it lacks the perceptual qualities that attract and hold our attention so, when designing digital learning, we should perhaps aim to maximise efficiency while tempering our expectations about sustained attention and enjoyment. As a result the recommendations for digital learning design, at least for the types of two-dimensional digital learning currently in common use, emerging from this thesis largely consist of a re-statement of established best practices and a recommendation to consider the learner groups to whom the benefits of efficient learning are likely to outweigh the loss of “the little things that make you human”. The conceptual and methodological contributions of this work are more substantial, and will be summarised next.

Firstly, I have proposed a mechanism by which the perceptual poverty of screen-based learning may influence learning engagement. Although the idea of embodied learning has recently been introduced to medical education (for example, van der Schaaf, 2019), I am not aware of work that makes this specific link between embodied cognition and digital learning disengagement. To do this, I have drawn on and extended the work of Silvan Tomkins, an academic whose work I believe has been unjustifiably neglected. Tomkins tells us that fatigue and anomie result when the affective response of interest-excitement is absent, and I suggest that curiosity should be considered a drive that can be paired with interest-excitement, adding to Tomkins' list of drive-affect pairings. I argue that interest-excitement is generated by satisfaction of the curiosity drive, and that this applies to perceptual as well as intellectual curiosity. D'Mello (2021) recently reviewed the concept of learning engagement and concluded that it is poorly defined, and that this makes investigation difficult. Although good tools for assessing affect remain elusive, a theoretical definition of learning engagement - such as the one presented here - could be operationalised and used to structure enquiry into learning engagement.

I found Tomkins' work almost by accident, while I was looking for a reference for "script theory" during a conceptual analysis of clinical reasoning that I undertook early in my research. It took a long time to find some of Tomkins' work, possibly as a consequence of internet search engines presenting the most popular results first, but it was well worth the effort. I found a rich vein of imaginative, well argued, consilient theory at around the same time I had started wondering if an affective response to the learning medium would be an interesting line of enquiry. Alexander Bain was also a surprise. Darwin had quoted him in his work on emotions (Darwin, 1904) and looking at Bain's original work, I was

surprised to find what I had thought were modern neurophilosophical notions of the embodied mind, clearly argued in the 1860s. Brian Epstein (2015) argues that the dearth of productive theory in the social sciences is a result of a failure of metaphysics – a failure to define adequately the properties and relationships of social entities. As a result, he argues, we tend to focus on causes and relationships before we have understood the nature of what we are studying; a critique that might apply to the study of entities such as social and individual learning. Fortunately, Bain offers a useful ontology of the mind that explains why the presence of others is conducive to learning, while Tomkins offers a detailed examination of affect and its relationship to meaning. It made me wonder how many other potentially productive philosophical and theoretical contributions have lain half buried and forgotten for decades, and I would claim that applying the work of Tomkins and Bain to digital learning engagement is another contribution of this work - although it is somewhat unlikely that using Bain and Tomkins in a single thesis will generate the "critical mass" of followers necessary for interest in them to be propagated. There is probably interesting work to be done in understanding how theoretical contributions diffuse in the social sciences and how (non) theories such as Actor Network Theory, for example, gain such considerable traction.

Triangulating Tomkins' theories with Personal Construct Psychology was extremely helpful; Kelly's work offered extra metaphorical depth, a logic of enquiry, and a very useful research tool. The repertory grid interviews allowed me to probe students' feelings about digital learning in a way that I had failed to achieve in the standard research interviews that I undertook during the design research stage of my thesis [Appendix B]. The idea of a construct as a dimension of appraisal with two poles is particularly powerful

because, after identifying a discriminating characteristic, identification of the opposite pole indicated how the participant thought about that characteristic. Constructs with digital fatigue at one pole usually had interest-excitement at the opposite pole, and this suggests that digital fatigue can be considered an affective response. One of the limitations of using the repertory grid as a research tool is the limited number of methods available for analysing multiple grids without losing data, and a further contribution of this thesis is the use of theoretically defined categories to group data, so that theoretical predictions can be compared to empirical evidence. I have not seen this approach used elsewhere and it may be useful to other researchers interested in using the repertory grid to investigate shared constructions in groups of individuals.

The work here does raise further questions. My arguments have been based on the students' experiences of two-dimensional screen-based learning presented to them during the Covid-19 pandemic, and the phenomenon of perceptual poverty that they expressed during my interviews with them. I can therefore make no claim about the perceptual-curiosity and interest-excitement that might be generated by three-dimensional virtual worlds. Li and Lefevre (2020) recently described the holographic representation of physically distant presenters in three seminars in a university setting. Students were enthusiastic and reported enjoyment, along with an increased sense of presenter presence, compared with video-conferencing. However, the authors did point out that some of the enthusiasm was related to the novelty of the technology, and the audience was present in a physical lecture hall with at least one live presenter. While it is difficult to see this as an exemplar of digital learning made perceptually interesting, the audience did report a feeling of connection with the hologram and improved attention to

what was being said. This does seem a more promising prospect for generating perceptual curiosity and interest-excitement than the more cartoon-like three dimensional virtual worlds that are populated by avatars, although it is difficult to distinguish between interest-excitement directed towards a new technology, and interest-excitement generated by inherent perceptual curiosity about living beings in a real world. Perhaps the interest-excitement in some of the newer three-dimensional technologies may wane when the "wow" factor has worn off and the technology becomes mundane. It would be interesting to explore students' affective responses to learning in a three dimensional world, but the limited empirical work available suggests that they may not be completely positive. Eringfeld (2021) explored the hopes and fears of students and faculty for higher education after the Covid-19 pandemic. She found that the dominant view of a dystopic post-Covid future was of a fully online university, devoid of human contact and real physical environments. One of her participants described a "hellish" scenario, where students put on their headsets and "sort of *simulate* what life *is*" (Eringfeld, 2021, p. 152 italics in original). It seems that even three dimensional, virtual worlds may be devoid of "the little things that make us human".

Digital learning clearly has benefits, and is here to stay. The scalability of teaching resources is undeniable, even though efforts to provide teaching at scale have been disappointing. The flexibility of "anytime, anywhere" asynchronous resources also opens the possibility of making learning available to populations who were excluded by geography, or by existing time commitments that meant they could not attend time-tabled teaching. My analysis of the drawbacks of digital teaching is not a Luddite

argument that we should abandon it and revert to traditional methods, it is rather an argument that these efficiency gains come at a cost, and that we should recognise those costs. We should understand the contexts where digital teaching offers an advantage, and design and deliver teaching that is as good as possible within the limits that are *inherent to the medium*, and we should continue to value face-to-face teaching. When choosing a teaching medium, we have to make choices between the efficient and the human.

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Appendices

Appendix A: Strategies for digital clinical teaching during the Covid-19 pandemic: a scoping review

PDF of submission to journal “Medical Science Educator” January 2023. Undergoing peer review at time of this submission

Appendix B: What can we learn from designing a learning game?

Work presented at the 17th annual International Technology Education and Development Conference (INTED) 2023

[Add PDF before submission]

WHAT CAN WE LEARN FROM DESIGNING A LEARNING GAME?

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Abstract

Background:
Games can be highly absorbing: by definition, people who play them have chosen to try to overcome unnecessary obstacles in order to achieve uncertain outcomes. The attributes of digital games that generate this behaviour are of considerable interest to educators, because the motivation to play and to persist in trying to improve scores that characterises game-playing is rarely found in digital learning. It is assumed that incorporating game features into digital learning will improve engagement, but there is little empirical support for this claim. No conclusions about the effectiveness of game-based learning could be drawn from at least three recent, published systematic reviews, and most primary studies are under-theorised.

Methods and Results:
Design research is promoted as a method to test and build theory while developing learning materials. We report the use of design research to build and analyse a learning game that was designed to support the development of clinical reasoning skills in senior medical students transitioning to early professional practice. The design passed through three iterations, using two different platforms and basing the design of new prototypes on user feedback from the previous iteration. The last iteration used interactive story telling software to develop a small html file that could be opened in a browser without the need for log-ins. The story telling software allowed the development of quite complicated branching scenarios, and the game attributes of meaningful choice, safe failure, the development of a valued identity, and learning in the zone of proximal development were successfully instantiated. The two cognitive processes of clinical reasoning: generating a shortlist of reasonable hypotheses and then adjudicating between options, were also represented in the final iteration. However, while a small number of incentivised research participants found the game realistic and offered glowing feedback, no potential user engaged with the game outside the research setting.

Conclusions:
Our work did not support the argument that learning games increase engagement and it raised questions about the perceived value of new medical student learning apps in an already crowded market. Design research is promoted as a method that builds theory during a design process, but quite how theory should be built is debated. In practice, we found that design research has limited potential to build theory because it is not powered to test links between individual design features, mechanisms and outcomes. This means that is can only determine that a design works in a particular context, not how it works and this limits the transferability of findings.

Keywords: Game-based learning, Design Research, Medical Students.

INTRODUCTION

For many new doctors, the transition from the protected learning environment of medical school to a high pressure work environment is a big one and many first year doctors feel unprepared to manage ill patients [1]. Lack of clinical exposure in medical school has been identified as an important contributory factor [1], a problem likely to have been exacerbated in some recent cohorts when Covid-19 changed hospital caseloads and access to real patients was limited by social distancing requirements. Digital learning offers an appealing approach to meet this learning need because of its

scalability and convenience, but it presents two design challenges: simulating the process of clinical reasoning, and designing digital tools that promote learning engagement.
It has been suggested that game-based learning promotes digital learning engagement. Drawing on learning theories such as Achievement Goal Theory [2]; Vygotsky's Zone of Proximal Development [3], [4]; and Self-Determination Theory [5], as well as the features of popular games [6], several attributes of engaging games have been identified. These include meaningful choice, safe failure, exploring the "zone of proximal development", and adoption of a valued identity [7]. Scoring systems also allow the user to track his or her progress, and are thought to encourage repeated attempts at playing [8]. However, although theory suggests that successful instantiation of these attributes in digital content should be experienced as engaging and motivating, no conclusions about the effectiveness of game-based approaches could be drawn from three recent high quality systematic reviews of their use in health professions education [9], [10], [11]. An important criticism of primary research in game-based learning, is that it is under-theorized [10], [11].
Design research is an approach in which researchers attempt to create and progressively improve artefacts while, at the same time, testing and building theory [12]. There is, however, a lack of clarity about what sort of theory can be tested and developed in design research [13], with under-theorization contributing to trivial results when design research is used [14]. Sandoval [15] has suggested using a "conjecture map" to make explicit the links between design features, the mechanisms they are thought to activate, and the outcomes. The conjecture map allows users to distinguish between "design conjectures", which are theories about how design features should function, and "theoretical conjectures", which are theories about how that function produces an outcome. A conjecture map, used within design research, might then offer a framework for testing theories about how gamified learning stimulates digital learning engagement.

METHODOLOGY

A conjecture map was created to make explicit the design intentions, their instantiation, the intended outcomes and the mediating processes for a learning game that used authentic dilemmas to offer new doctors guided practice in clinical decision-making. It is shown in Fig. 1

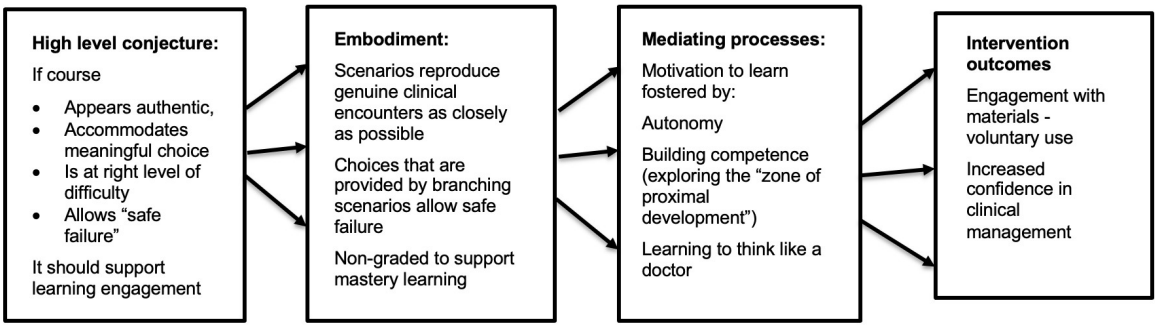

Figure 1: Conjecture map showing how a clinical learning game is assumed to stimulate learning engagement. Based on Sandoval [15].

An initial stage, in which new doctors were interviewed to determine content needs and broad design preferences, was followed by a stage of prototyping and testing, using three different “gamified” prototypes in an iterative process of design modification based on user feedback. Data from individual interviews and a focus group discussion were recorded and transcribed verbatim. Transcripts were imported into Atlas-ti version 9.1.1 (ATLAS ti Scientific Software GmbH, Berlin) and a data-driven, exploratory approach was used to identify themes about content needs, design likes and design dislikes

RESULTS

Technological platform

Three different technologies were explored, a conventional learning management system, a game engine, and interactive story telling software. A first prototype used a classroom that was created on a commercial learning management system. A simulated patient encounter was created using a cell-phone audio recording in which a volunteer medical student took a history from a simulated patient and discussed the differential diagnosis with a tutor. The audio recordings were augmented with still photographs, simulated blood results and a single CT scan image. H5p software was used to create branching scenarios, with one major decision point and an additional two decision points on distractor pathways. Twenty six students and 6 faculty were invited to join the classroom. Ten accepted the invitation, four of these were faculty members. No users completed the scenario.
A game engine, Unity [16], was next explored because this offered the possibility of creating a scenario with higher fidelity that might prove more interesting for users and would potentially allow a later move to an immersive environment using virtual reality. However, not only were the required coding skills considerable, but users would have needed to install the game engine. This was a large file that required time and good bandwidth for download. Both these factors made it unsuitable for rapid prototyping. The low numbers of students logging onto the Canvas classroom suggested that the need to create accounts and log-ins might be a barrier to use that could become insurmountable with the use of a game engine.
The open source interactive story-telling software Twine version 2.3.13 [17] was used next and was found to be very satisfactory. The drag and drop canvas made it possible to create and keep track of quite complex branches, and minimal coding skills and no technical support were required. Perhaps most importantly for user engagement, the scenario could be sent as a small html file that could be opened in a web browser and did not require a log in or any additional downloads.
Twine was therefore selected as a user-friendly, flexible tool that allowed complex decision architectures to be designed and was used in two more prototypes.

Further Scenarios

Prototype 2:
In the first Twine prototype, an interactive story called “A difficult morning” was created, in which a junior doctor arrives on the ward to be presented with three potentially serious problems. He or she had to decide whom to see first, what initial management is appropriate, and when to ask for help. The following game-based principles were embodied:
Valued identify: The scenarios were designed to be as authentic as possible to activate the users’ identities as doctors. They included background sound effects with heart monitors and alarms, with a “flat line” audio clip for a significant mistake.
Meaningful choice: Twine allowed the creation of quite complex branching scenarios which aimed to re-produce authentic dilemmas.
Working in the Zone of Proximal Development. The choices required were perhaps at the limit of what would be expected of an F1 (first Foundation Year doctor), because senior support was deliberately made unavailable. However, the decisions demanded knowledge that should be available to an F1.
Safe failure: Participants start the scenario with a clinical credibility score of 100. Clinical credibility was lost if sub-optimal decisions were made, but could be replenished by undertaking short learning activities that were available in a Learning Store embedded in the scenario. The aim was to finish the scenario with as much clinical credibility as possible.
Individual feedback was sought from a final year medical student, an F1 doctor, a peri-operative care trainee and two surgical consultants. Modifications were made to the design and content, and the modified scenario was then given to 20 F1 doctors, 7 of whom participated in a lively focus group discussion. New doctors were chosen over senior medical students, because it became clear that the medical students had already been offered multiple digital resources during Covid that the recently graduated doctors may have missed out on.
Although it had been planned that participants would work through the scenario prior to the discussion, none had accessed it, so the focus group began with them quickly working through it at the beginning of the session. Discussion showed that the scenario had been set at the right level and was realistic, but there was a strong preoccupation with fairness of the scoring system and some of the drastic drops in their “clinical credibility” scores:

F1006: It made me feel kind of sad that I started off high and I was just going to lose [laughs]
F1007: … “I am not credible”

F1008: I thought it was quite a big drop, from 100 to 50 for the one choice

F1006: Oh yeah! I was like “Oh my God I’m literally awful” and then I was making all these good decisions and it made…like no one was saying “well done” or anything
F1009: Just like appraisals! [laughter]
F1006: It was horrible! [laughs]

Several suggestions regarding content and layout were made and these were incorporated into the next version.

Prototype 3:

The next scenario was also built in Twine and was called “An afternoon of trivia?” It responded to a situation, articulated by the focus group participants, in which they are frequently given lists of “jobs” by the nursing team and have an underlying worry that they will miss an important clinical problem if they uncritically do what is asked of them. In “An afternoon of trivia?”, the user returns from lunch to find a list of nine tasks for nine patients. He or she must decide whether to do the task, ask for more information, or go to see the patient. A thumbnail sketch of each clinical picture can be seen before making the decision, but users are limited to four requests for information and four visits, and therefore have to prioritize. This reproduces the clinical reasoning skill of considering alternative diagnoses, asking themselves the question *“what else might be causing this?”* Two patients with potentially life-threatening problems are concealed in the list of apparently trivial tasks.
This scenario provided more materials in the Learning Store, along with better access to them: a “spoke and hub” design was used that took users back to the jobs list after each patient, and the Learning Store could be accessed from this page. In addition, the scoring system was modified so that fewer points were lost for sub-optimal decisions.
All 7 participants were sent the new prototype 5 weeks after the focus group, and two surgical consultants were also asked for feedback. One participant, a junior doctor in the focus group, responded:

“I just wanted to say I thought version 2 was absolutely fantastic!! It felt very accurate to real FY1 [Foundation Year 1] life…. I felt the scoring was also more fair and encouraging this time…Its clear how much effort has been put into the learning store too, and I have to say I thought it was perfect! Just the right amount of information and so so useful! I actually think you should include all of that in the F1 handbook for SEU [Surgical Emergency Unit], I learnt a couple of things from it that I wish I knew at the start. Thank you so much for listening to our feedback, I’m so impressed with this! The new F1s are super lucky to have this”

No other feedback was offered; on later follow up of non-responders, two additional participants had not been aware of the revised version in their mailboxes but planned to review it at some point.

Using the conjecture map

Despite successful instantiation of game-based design features and some positive feedback, use of the learning tool outside an incentivized research environment was minimal. It was not possible to explore this more critically using the conjecture map. This is because testing of design conjectures requires “methods that can identify whether the expected mediating process does in fact emerge and that can provide evidence to trace

that process back to designed elements", while testing theoretical conjectures, requires "appropriate measures of targeted outcomes" that can be traced back to their explanatory mechanisms [15]. In practice, it was not possible to isolate the links between individual elements of a conjecture map for a multi-feature learning tool deployed in a complex learning environment. Sandoval recognises this in a worked example, producing a conjecture map that shows embodied elements *jointly* activating mediating processes which then *jointly* produce outcomes [15].

CONCLUSIONS

The most useful technology was found to be interactive story telling software, which offered a lightweight file that did not require log ins or account management and could simply be opened in the browser.

The participants' design preferences were met, and game-based features appeared to be successfully instantiated, but there was minimal use of the tool, something that contrasted strongly with a hunger for face-to-face "on the job" clinical teaching that had been observed in this participant group at work.

There was no evidence that including game-based features fostered learning engagement in this group, but it was not possible to generate theoretical insights about engagement or motivation from the conjecture map because it was not possible to identify individual causal links. The "whole system" approach is inherent in design research [18], difficult to escape, and probably limits its usefulness in generating theoretical insights. The difficulty in making knowledge claims about "whole system" experiments may be a reason why design research has often been disappointing in educational research [13], [14]. Van Gaalen [11] also points out the difficulty of whole system experiments in his review of game-based design in medical education, and his call to focus on the mechanisms activated by individual game attributes, rather than the whole game, is supported by this research. In particular, the use of scoring systems merits closer examination because they may encourage a pre-occupation with scores rather than learning.

The inertia shown by the group of users when presented with a learning tool that had "followed all the rules" and the disconnect between enthusiastic verbal responses and actual use of the tool were interesting findings. This may partly have been because the users for this tool were busy adults, working in a stressful job, and may not have been enthusiastic about using their own time to play a learning game. Invitations and new prototypes may also have become buried in the large volume of spammed mail that these doctors tend to receive from their employers. However, these are unlikely to be complete explanations: even when two, apparently genuinely enthusiastic doctors were directed to the latest version, they did not get around to using it. It seems likely that there is an issue about the way digital learning media are perceived and valued by users. This, together with the conditions under which professional learners will voluntarily engage with screen-based learning, is worth exploring further.

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Appendix C: Codebook

Note:
Black text indicates student-identified constructs used as codes
Red text indicates elements
Blue text indicates researcher identified codes

Code	Code Group 1	Code Group 2	Code Group 3
Able to concentrate - Susceptible to interference	Focus and concentration		
Active - using info - Passive - receiving info	Processing	Active or passive	
Affective responses	Affective responses		
Allocation to specific time/place - Any time or place	Time	Scenes	Structure
Allows in-depth learning - More superficial learning	Processing		
Allows response - No input from me	Responsive	Active or passive	
Anxiety - Supportive/nurturing	Affective responses		
Anytime - Live	Time		
Arborescent - Rhizomatic	Structure		
Attention is focussed - Can multitask	Focus and concentration		
Being active - Being passive	Active or passive		
Being present - Disengaged	Processing	Perception	
Bench marking	Interaction with other people		
Camaraderie - Loneliness	Interaction with other people		
Can control pace - Others control pace	Time	Responsive	
Can have conversation with teacher - No live-time response	Interaction with other people		
Can muddle me - Clarity	Processing		
Can navigate easily - Cumbersome	Finding information		
Can read body language - Blank space	Perception		
Can revisit - Must keep up	Time		
Can revisit - Once it's gone, it's gone	Time		
Can take my time - Time pressure	Time		
Captivating - Easily distracted	Focus and concentration		
Choice switching	Focus and concentration		

Choose info I want - One size fits all	Finding information	Responsive
Clarification is acceptable - No opportunities to clarify	Questioning	
Cognition		
Collective learning - Solitary learning	Interaction with other people	
Communication between people - Solitary consumption	Interaction with other people	
Competitive - Opportunities to co-learn	Interaction with other people	
Confidence in information	Confidence in information	
Confidence in information - Unknown quality of information	Confidence in information	
Confident about information - Scepticism	Confidence in information	
Content heavy - Content light	Structure	
Context where worry about other people - Context where confident	Affective responses	Interaction with other people
Contextualised info - Abstract concepts	Finding information	Structure
Control pace - Cannot control pace	Time	Responsive
Convenient - Inconvenient		
Conversation - One way flow of information	Active or passive	
Curated info - Everything	Finding information	Structure
Decontextualised learning - Learning in context	Structure	
Delivers framework - Fills in gaps	Finding information	Structure
Demonstrations - Written or verbal	Structure	
Demoralising - Energised	Affective responses	
Difficult to process info - Easy to absorb	Processing	
Direct information - Signposting	Finding information	
Directed search - Background knowledge	Finding information	
Directed search for information - Willing to explore a topic	Finding information	
Discreet activity - Continuous/never ending activity	Scenes	Structure
Discretionary tasking interleaving	Focus and concentration	
Discriminating content - Brain dump	Finding information	
Distinct learning environment - Blurred learning environment	Scenes	
Distracted by others - Don't notice others	Interaction with other people	
Distractions	Focus and concentration	
Do it at own pace - Must keep up	Time	
Doubtful credibility - Trustworthy	Confidence in information	
Draining - Intellectual energy	Affective responses	Fatigue

Draining - Stimulating	Affective responses	Fatigue	
e-books	Elements		
Easier to lose focus - More engaged	Focus and concentration		
Easier to retain info - Harder to retain info	Processing		
Easy to ask questions - Intimidating	Questioning		
Easy to be passive - Have to pay attention	Active or passive		
Easy to digest - Difficult to process	Processing		
Easy to distinguish relevant vs nonrelevant info - Don't know what is relevant or important	Finding information		
Easy to get distracted - Attention grabbing	Focus and concentration		
Easy to retain info - Difficult to retain info	Processing		
Efficiency - Not good use of time	Time		
Elements	Elements		
Emotional engagement - Emotionally disengaged	Affective responses		
Empowering - Disempowering	Affective responses		
Engage multiple senses - One dimensional	Perception		
Enriching - Bland/uninspiring	Affective responses		
Environment conducive to focus - Environment with other expectations of me	Scenes	Focus and concentration	
Everyone fed up - There because you want to be	Affective responses		
Exhausting - Invigorating	Fatigue	Focus and concentration	Affective responses
Exhausting - Sustainable (can keep going)	Fatigue	Focus and concentration	Affective responses
Expectations of behaviour - Do my own thing	Interaction with other people		
Express opinion without expecting answers - Direct answers to questions	Interaction with other people		
Express yourself - Pre-defined etiquette	Interaction with other people		
Face-to-face lectures	Elements		
Face-to-face tutorials	Elements		
Fake - Genuine	Perception		
Fatigue	Fatigue		
Fear of exposure - Being comfortable	Affective responses		
Fear of seeming stupid - Comfortable	Affective responses		
Feels dated - Brand new	Perception		
Flexible - Structured	Structure	Responsive	
Focus and concentration	Focus and concentration		
Focussed - Butterfly	Focus and concentration		

Forces you to process info - Can wash over you	Focus and concentration	Processing
Fosters deeper thinking - Mechanical	Processing	
Fulfilling - Unfulfilling	Affective responses	
Game-based learning	Elements	
Going down rabbit holes - Get relevant info quickly	Finding information	
Good use of my time - Waste of my time	Time	
Google search	Elements	
Harder to concentrate - Focussed	Focus and concentration	
Have to be there - Can do in my own time	Time	
Holds attention - Fails to hold attention	Focus and concentration	
Holds attention - Scope for distraction	Focus and concentration	
Human connection - No feedback	Perception	Interaction with other people
I am involved - Passive consumer	Active or passive	
I can determine flow of information - Inflexible information flow	Responsive	
I direct information flow - Just sitting there	Responsive	Active or passive
I have control over info - Others control info	Responsive	Interaction with other people
Immediate feedback - Delayed/no feedback	Responsive	Interaction with other people
Information overload - Manageable information load	Finding information	
Information relevant to course/exams - Wider relevance of info	Finding information	
Inter-personal interactions - Impresonal interactions	Interaction with other people	
Interaction with others	Interaction with other people	
Interaction with others - Solitary	Interaction with other people	
Know what is essential - Off on a tangent	Finding information	
Know what is important - Don't know what to prioritise	Finding information	
Lead conversation - Passive	Active or passive	
Learn from others - Individual learning	Interaction with other people	
Lends itself to multitaking - Demands full attention	Focus and concentration	
Limited to exhange of information - A social component	Interaction with other people	
Live digital lectures	Elements	
Live feedback - Disconnected	Perception	
Low effort:magic ratio - High effort:magic ratio		
Low value - High value		

Multi-directional - Unidirectional		
Multi-tasking	Focus and concentration	
Must focus - Can multitask	Focus and concentration	
Must get it right first time - Can revise things	Time	
Must learn in the moment - Can put it off	Time	
Must seize opportunity - Easy to put off	Time	
Need to be there specific time - Flexible timing	Time	
Needs vice-like focus - Thinking about something else	Focus and concentration	
No visual cues - Visual feedback	Perception	
Opportunities for clarification - Nobody to answer questions	Questioning	
Opportunities to interact - Uninspired	Interaction with other people	Active or passive
Opportunity to ask questions - Questions unanswered	Questioning	
Opportunity to ask questions - Set content	Questioning	
Opportunity to enquire - No opportunity to enquire	Questioning	
Opportunity to multitask - No opportunity to multitask	Focus and concentration	
Others judge you - Uninhibited thought	Interaction with other people	
Passive - Active	Active or passive	
Passive - Interactive	Active or passive	
Perception	Perception	
Possible to interact - No direct interaction	Active or passive	
Practicing a skill - Learning facts	Active or passive	
Pre-defined content - Flexible content	Responsive	
Pressure to perform - Pressure free	Affective responses	
Processing	Processing	
Programmed activities - In own time	Time	
Provides knowledge base - Filling in gaps	Structure	
Pushing you forward - Passive	Active or passive	
Questioning	Questioning	
Reading an online article	Elements	
Reading and responding to emails	Elements	
Reading from a paper book	Elements	
Real - One dimensional	Perception	
Real world things - Artificially constructed		

Recorded digital lectures	Elements		
Relaxing - Stressful	Affective responses		
Relevance of information	Finding information		
Reliable info - Misinformation	Confidence in information		
Requires concentration - Passive activity	Focus and concentration	Active or passive	
Requires preparation - Just show up	Structure		
Responds to audience - Inflexible	Interaction with other people	Responsive	Perception
Responsive info delivery - Inflexible info delivery	Responsive		
Scene recognition	Scenes		
Scope for distraction - Captures attention	Focus and concentration		
Self directed search - Others directing information	Structure	Interaction with other people	
Separate home and work - Lack of boundaries	Scenes		
Setting commands attention - Setting is comfortable	Scenes	Focus and concentration	
Single sense - Multisense	Perception		
Sit and absorb - Actively seek info	Processing	Active or passive	
Social interactions - Isolated	Interaction with other people		
Social pressure to pay attention - Isolated learning	Interaction with other people		
Specifically academic - Use for admin or other	Structure		
Stale/dry - Inspiring	Affective responses		
Stay alert - Not processing	Focus and concentration	Processing	
Sticks in my mind - Floating words	Processing		
Stimulating - Mind numbing	Affective responses	Fatigue	
Stories - Disjointed/robotic			
Stressful - Non-stressful	Affective responses		
Structured - Self-directed	Structure		
Succinct - Waffle	Finding information		
Switch off easily - Engaging	Focus and concentration		
Tailored content - One level	Responsive		
Tailored to my needs - Not relevant to me	Finding information	Responsive	
Take breaks	Fatigue		
Taking a patient's history	Elements		
Taps into existing learning - Fragmented	Structure		
Teacher can adjust - Inflexibility	Responsive		

Teaching at you - Independent learning	Structure
Technical problems	
The little things that make you human - Disconected	Perception
Think about own behaviour - Not responsible for how I appear	Interaction with other people
Thinking about a response - Taking in information	Processing
Time consuming	Time
Time critical - Can take my time	Time
Time flexible - Time rigid	Time
Time restricted (learn in the moment) - Anytime learning	Time
Too much choice	
Too much info - Succinct info	Finding information
Trust info - Suspect info	Confidence in information
Two way conversation - Speaking at you	Active or passive
Two-way process - Non-interactive	Active or passive
Uses one sense - Uses multiple senses	Perception
Using a chatbox	Elements
Using social media	Elements
Vulnerable to comparison - No risk of judgement	Affective responses
Want it to finish - Want to know more	Affective responses
Wastes time - Productive	Time
With purpose - No specific purpose	
YouTube videos	Elements

Appendix D: Two versus three dimensional biplot representations

The repertory grid is a data matrix that potentially contains a large number of relationships between elements and between elements and constructs. A technique for reducing these relationships to a handful of dimensions is useful for looking for patterns in the data, but dimension reduction comes at the cost of a loss of information. This means that, when presenting analyses based on dimension reduction, decisions have to be made about the trade off between clarity and loss of information.

Biplots provide a spatial representation of how participants think about the chosen elements, both in terms of their relationship to each other, and in terms of their relationships to the constructs. Clustering of elements can be visualised, together with the constructions that determine cluster patterns, but the visual representation is limited to two or three dimensions.

I have chosen to use two dimensional biplots that show the first two dimensions (the two dimensions that represent the greatest variance) and drop the third dimension because I determined that a two dimensional plot was considerably easier to interpret and that this outweighed the information loss. I will illustrate this with plots from the two themes most germane to my hypothesis, “Affective Response” and “Scenes.”

The computation underlying plots in the OpenRepGrid package is singular value decomposition, and the data are centred across constructs. The percentage variance explained by the first two dimensions is shown on the X and Y axes of the two

dimensional biplots generated by OpenRepGrid. I have also used R to produce a scree plot of the variance explained by the first 12 dimensions, and a calculation for the variance explained by the third dimension, using the same data treatment as OpenRepGrid.

Theme “Scenes”

In the following figures, I will firstly illustrate how much of the variance in the data is explained by successive dimensions, and then compare three graphical representations of the biplot: the standard 2D biplot, the “pseudo3D” biplot, and a 3D interactive biplot.

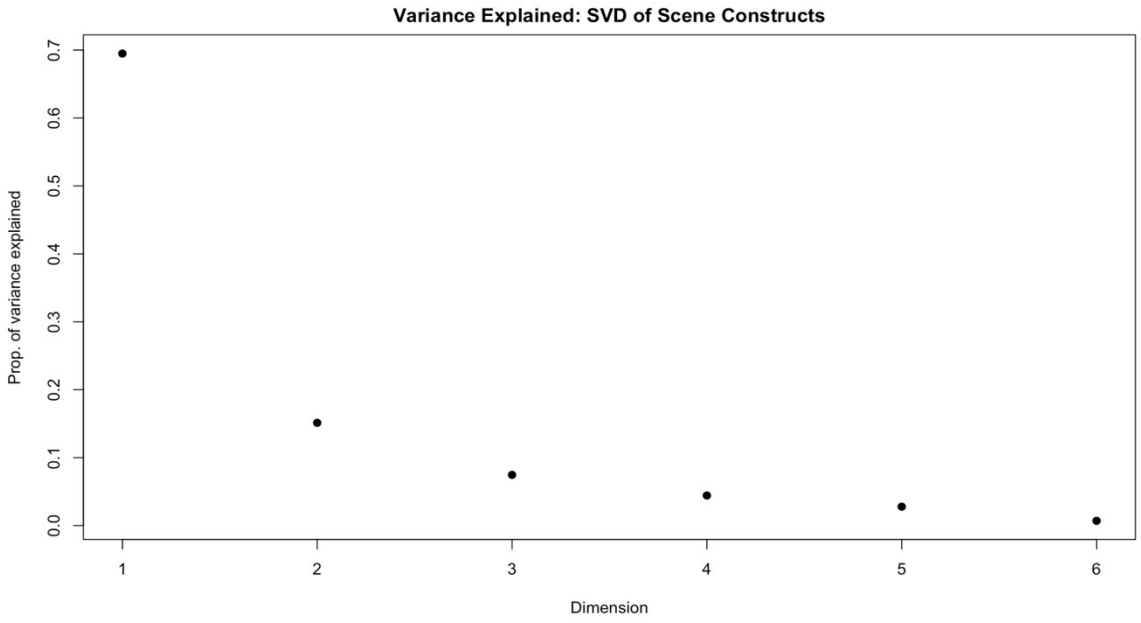

Figure D1: Variance explained in the first six dimensions after singular value decomposition of data in the theme “Scenes”

The values returned by R for the percentage variance explained by first three dimensions are: 1st: 69.5% 2nd: 15.1% 3rd: 7.5%

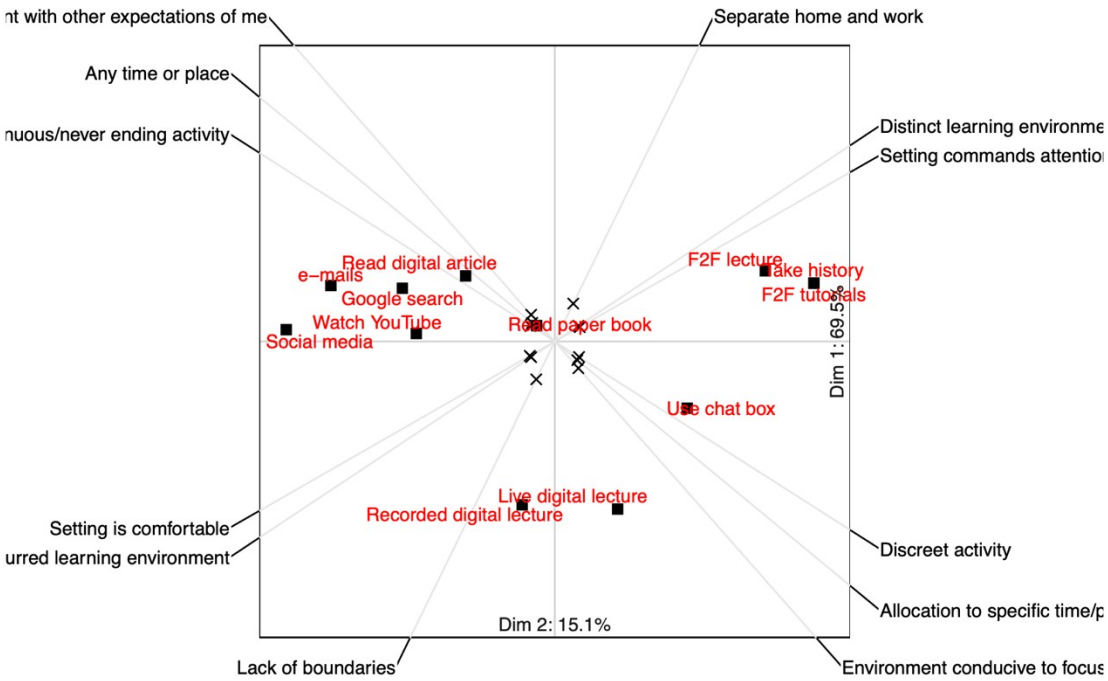

Figure D2: Standard two dimensional biplot of the theme “Scenes”.

I find that the standard biplot shown in Fig. D2 offers a fairly straightforward separation of elements that representing discreet activities (which cluster towards the right of the x axis) and those that permeate the rest of life (that cluster towards the left). This finding is discussed further in the Results section of the thesis.

Compare this with a “pseudo3D” biplot in Figure D3. In this plot, an attempt is made to visualise the third dimension using different intensities and sizes of font. However, I find that this creates a misleading impression of greater salience for the elements and constructs represented as “closer” to the reader without indicating any new patterns

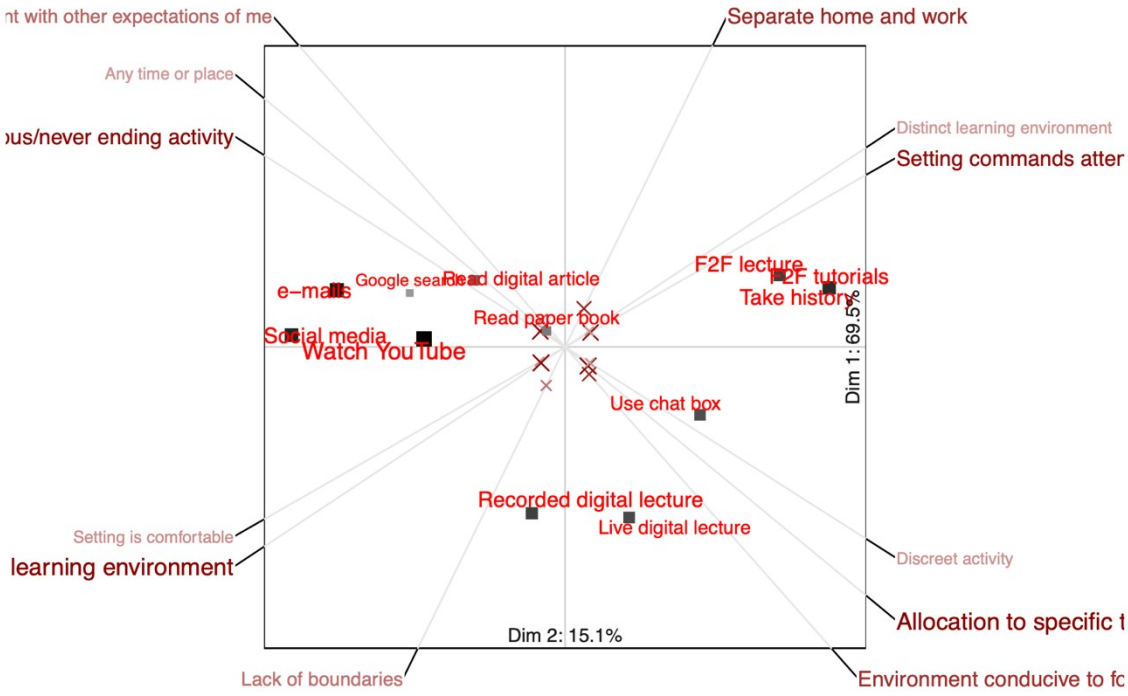

Figure D3: “Pseudo three-dimensional” biplot of the theme “Scenes”

An interactive, “click and drag”, 3D Biplot of the theme “Scenes” can be found at the following url: http://rpubs.com/Miranda_hmc/1003942

Although the 3D plot is more attractive and makes more sense than the pseudo-3D plot, it is more difficult to interpret than the standard 2D plot. In addition, a web-hosted plot may not be accessible across different browsers and devices, and may not be available in the longer term.

In summary, an attempt to include the additional 7.5% of variance offered by the third dimension has resulted in plots that are more difficult to interpret. In the next section, I show the same plots and data for the theme “Affective”, for which the same argument can be made.

Theme “Affective”

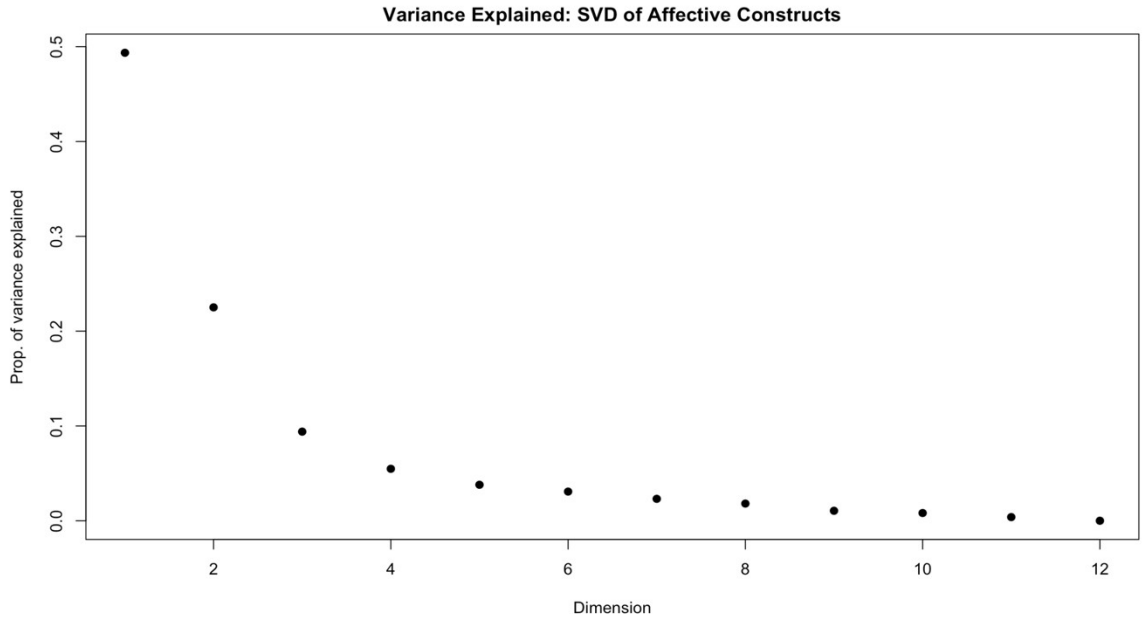

Figure D4: Variance explained in the first 12 dimensions after singular value decomposition of data in the theme “Affective.”

Percentage variance explained by first three dimensions: 1st: 49.4, 2nd: 22.5, 3rd: 9.4%

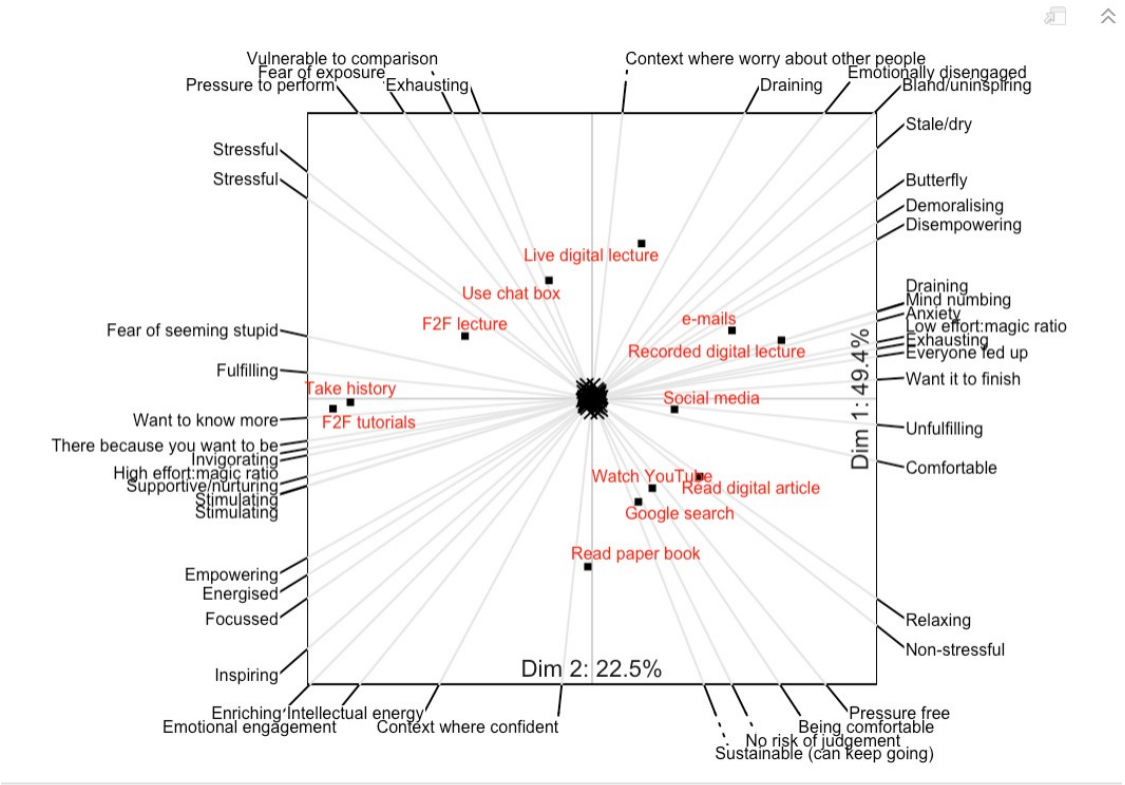

Figure D5: Standard two-dimensional biplot of the theme “Affective”

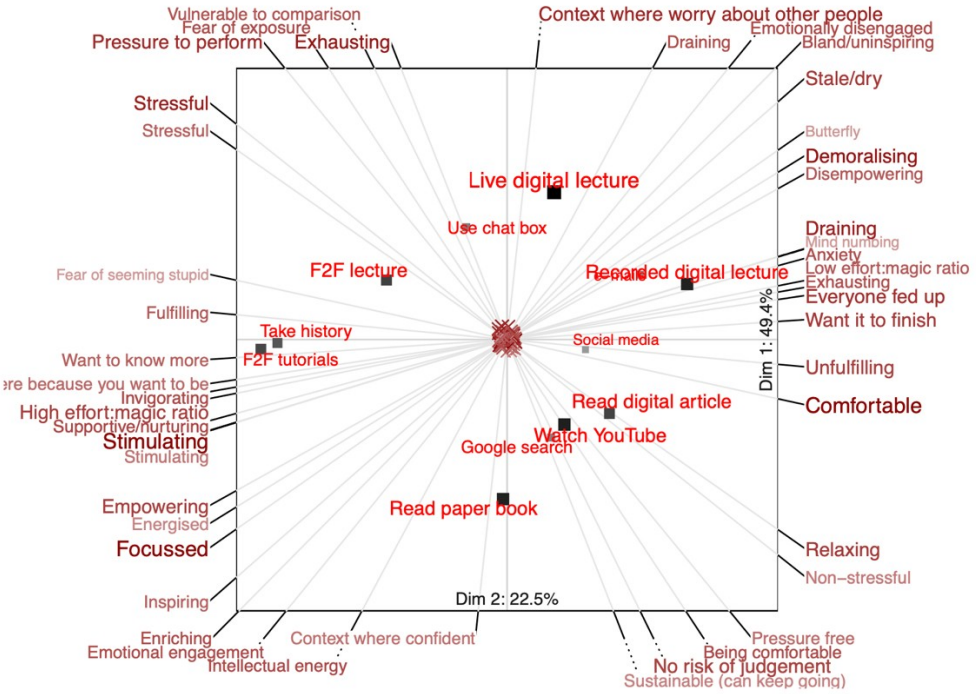

Figure D6: “Pseudo three-dimensional” biplot of the theme “Affective”

An interactive 3D biplot of the theme “Affective” can be found at the following url:

https://rpubs.com/Miranda_hmc/1003950