

Virtual Reality is ‘Finally Here’: A Qualitative Exploration of Formal Determinants of Player Experience in VR

Dooley Murphy

Department of Media, Cognition and Communication

University of Copenhagen

Karen Blixens Vej 4, 2300 Copenhagen

+45 52 60 58 10

dooleymurphy@gmail.com

ABSTRACT

It is already a truism that consumer virtual reality (VR) systems offer sensorially immersive first-person experiences that differ markedly from those begat by traditional screen displays. But what are the implications of this for player experience? It is well-documented that VR can induce illusions of non-mediation; of spatial presence; of embodiment in avatars. This paper asks—and reports on—what common features of digital games are liable to be experienced as stressors (that is, as *beyond* optimally affective or intense) when the player perceives her avatar–self egocentrically as a ‘life-sized’, spatially present, and potentially vulnerable entity within the gameworld. The present paper describes and discusses findings from a qualitative content analysis of immersive virtual environments (IVEs) experienced via head-mounted display-based VR systems akin to those now commercially available. A purposive sample comprising video, photographic, and written documentation of IVEs ($n = 124$) from historical clinical VR and telepresence research is interrogated through the lens of cognitive media theory. Effecting a novel approach inspired by systematic review, the present study's observations and inferences regarding players' subjective experience of IVEs are presented alongside relevant findings from the research literature sampled. This produces a preliminary formal framework for discussing VR player experience as significantly structured by *patience* (cf. *agency*), with VR experiences eliciting self-directed affect, and thereby somewhat unintentionally engaging the player's body as a site for feedback.

Keywords

Affect, emotion, cognition, embodiment, experience, presence, virtual reality, VR

VR IS ‘FINALLY’ WHERE?

In the past few years, countless journalists and industry spokespeople have claimed that virtual reality (VR) is ‘finally here’. True enough, 2016 saw Oculus VR's *Rift*, HTC's *Vive*, and Sony's *PlayStation VR* join Samsung's smartphone-based *Gear VR* in offering affordable and compelling VR experiences to the consumer public. Indeed, it can be conservatively estimated that VR entertainment systems are now in the hands of no fewer than 5 million people worldwide, around half of which are ‘high-end’ systems (i.e., PC or console-based; Parfitt, 2016). Yet anybody who was attentive to science fiction and/or technological hype in the early 1990s will know that 2012—the year of Oculus VR's initial crowdfunding campaign—marked not the arrival of VR, but rather its renaissance.

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Broadly speaking, the VR systems of yesteryear were prohibitively expensive, impractically cumbersome, and technologically deficient. Released in 1991, the arcade-style *Virtuality* system is perhaps most similar in terms of material features to what high-end VR entertainment systems offer today. Yet the technical specifications of *Virtuality*'s tracking sensors and head-mounted display (HMD) effectively precluded the system from comfortably and uninterruptedly delivering the assemblable defining feature of VR experiences: the subjective illusion of spatial telepresence (hereafter *spatial presence*). By many accounts, the *Virtuality* system was more prone to confer motion sickness (simulator sickness) than spatial presence, which can be posited as a core component of a more global sense of presence; the holistic 'feeling of being there' (Heeter, 1992). Nevertheless, unlike Nintendo's monochromatic *Virtual Boy* (1995), the technicolour *Virtuality* system gave gamers and consumers a glimpse of what to expect from future generations of three-dimensional, first-person, stereoscopic VR replete with (prospectively) spatiotemporally precise tracking of head and hand movements affording intuitive, lifelike motion control.

'Where', then, is VR today? Clearly it is in the hands (and on the heads) of consumers. But one can argue, by extension, that VR also knocks at the door of game studies. While VR all but disappeared from public consciousness for the better part of two decades, a strong academic tradition remained in the form of presence research and, often relatedly, medical, therapeutic, or otherwise clinical VR experimental research (see Rivera et al. 2015 or Riva et al., 2015b for overviews). Conditions ranging from specific phobias to general anxiety disorders have been successfully treated adjunct to VR scenarios and the stimuli contained therein. The immediacy of experience afforded by immersive VR has been hailed as a 'royal road' to cognitive-behavioural and emotional change (J. Waterworth et al., 2015: 46); VR is an established and indispensable tool in the field of media-augmented therapy. But these facts present a double-edged sword. Early adopters of (esp. hackable, PC-based) VR have effectively purchased interactive display systems which, given the right content, can profoundly affect users' beliefs, attitudes, and actions at the micro-level (Madary & Metzinger, 2016). Dozens of studies sampled in this paper's empirical portion demonstrate as much (see Riva et al., 2015a for a third overview). VR has been seen to occasion effects ranging from increased empathy following the illusion of inhabiting another person's body (Maister et al., 2015), to the strong analgesic effect of distracting oneself from pain in one's own physical body during otherwise painful medical procedures (Li et al., 2011). Moreover, just as VR experiences can relieve pain and encourage prosocial behaviour, military-funded research has shown that so too can they be used to desensitize soldiers to potentially traumatic, violent situations (Rizzo et al., 2012). Furthermore, the long-term effects of immersion in VR remain largely unknown, and very few studies have investigated the effects of VR on children. It can thus be taken as imperative that researchers and scholars within the humanities and social sciences lay groundwork for the extrapolation of presence research, clinical VR research, as well as media influence and effects research into the nascent domain of VR-as-mainstream gaming apparatus.

The paper proceeds thusly. The following section presents a case for the aptness of a cognitivist interpretation of the study's qualitative data. Two subsections sketch accounts of spatial presence (premised to be an important hallmark of HMD-based VR) and, separately, affective-emotional experience in games. The study's methodology is described and justified. Findings are then presented, and contextualised and validated against the primary scientific literature sampled. Issues of patiency and ludic subjectivity, the player's body as a site for feedback, and VR ethics are outlined in closing.

THEORETICAL APPROACH

As is explained shortly (in the Methodology section), the present survey examines immersive virtual environments (IVEs) taken from a sample of literature spanning medical, clinical, psychological, social scientific, or otherwise experimental research. Those studies' IVEs are analysed through the lens of cognitive media theory (Nannicelli & Taberham, 2014), and the present paper's inferences regarding user/player experience are backed up by findings from said primary literature. Practitioners of cognitive media theory working within game studies include researchers and theorists Bernard Perron (2005), Felix Schröter (2016), and Andreas Gregersen (2014; Gregersen & Grodal, 2008). Cognitive media theory leverages knowledge about the function of audiovisual media technologies' material and formal–compositional features in relating spectator/user/player outcomes to more-or-less universal cognitive tendencies rooted in our mammalian, primate, and human biology. This ontologically naturalistic perspective accounts for degrees of potential variance among individuals, spectators, or players by foregrounding the empirically-backed claim that many aspects of humans' typical courses of embodied perception, appraisal, comprehension, and emotional engagement (or lack thereof) are evolutionarily-driven and therefore largely predictable, as well as generalisable across demographics or cultures (Barratt, 2014; Schröter 2016).

Spatial Presence

A further reason for seeking to understand the phenomenology of VR gaming through a cognitivist prism is that state-of-the-art theory in presence research demands that presence be viewed as an inherently embodied perceptual–cognitive phenomenon. Early treatments of a 'global' sense of presence in immersive media sought to understand the 'what' of the experience before attempting to explain the 'how' or the 'why'. One seminal contribution to the field famously characterised presence as involving such dimensions as realism, social richness, and transportation (Lombard & Ditton, 1997). Presence was—and arguably still can be—considered to be optimally active when multiple components are simultaneously engaged. (The complementary phenomenon of social co-presence is beyond the scope of this paper.) Throughout the 1990s, attempts to model the emergence of presence by-and-large remained *black box*-like. More recent treatments of spatial presence, however, have begun to gain purchase on the subjectively inaccessible cognitive mechanisms that enable users to unconsciously accept virtual environments as sufficiently place-like to be perceived as plausible (Slater, 2009). Brief summaries of two such recent accounts follow.

In Werner Wirth et al.'s (2007) process model of the formation of spatial presence experiences, spatial presence can be seen as necessitating VR users' sub-personal acceptance of (1) the spatial logic simulated in and by an IVE and (2) an egocentric (as opposed to an exo- or allocentric) reference frame of the sort inherent to a first-person perspective (1PP). To greatly paraphrase the model, spatial presence is reducible to VR users' unconscious acceptance of an avatar's egocentric reference frame and virtual peripersonal space as viable, supported by the 'tuning out' of contradictory sensory information from the physical environment. The model rightly suggests that isomorphism (accuracy; fidelity) of body part (esp. head) tracking and mapping is conducive to users' acceptance a virtual space as plausible or persuasive (Steuer, 1995). This tentative foregrounding of visuomotor congruity (i.e., the tight coupling of head/hand movements to the updating of the system's display) as a desirable condition for perception-driven spatial presence leaves room for hardware-agnostic definitions of the phenomenon. The model also does an excellent job of describing how a system's formal features and users' personological factors may interact as mutually co-compensating. For instance,

compelling, state-of-the-art graphical rendering may counterbalance a given user's lack of interest. Inversely, a user's willing involvement or absorption in a virtual simulation may compensate for technological shortcomings. However, by some of the authors' own admission, the model prioritises 'vision for perception' over 'vision for action' (Milner & Goodale, 2006). Accordingly, some of the work's contributors have since stated that the assumptions and implications of the model invite further consideration as to the role of *doing* in addition to simply *being* in a given IVE (Hartmann et al., 2015). In other words, in line with the thesis of affordance-based or ecological perception (Gibson, 1979), perceived possibilities to act seemingly also inform users' or players' implicit acceptance of IVEs as spatially credible, habitable, and explorable places populated by objects and agents that will act as though real.

In a 2009 paper aimed at conceptual disentanglement and development, Thomas Schubert notably characterises spatial presence as a 'cognitive feeling', or 'nonaffective feeling'. According to this view, spatial presence can be understood as a product of feedback from ongoing, unconscious cognitive processes that 'try to locate the human body in relation to its environment, and to determine possible interactions with it' (Schubert, 2009: 170). Indeed, spatial presence—as a primarily perceptual illusion—is evidently multimodal; it is not *solely* visual. While vision may in many cases remain the dominant or privileged perceptual modality in VR as in physical reality, audition (hearing) and proprioception (the sensation of one's bodily state and position) are also vital contributors to the emergence of a sense of spatial presence. Schubert observes (2009: 170) that:

Presence is enhanced when body movements in interaction effects are not just arbitrarily coupled (a mouse-click moves the virtual body forward), but coupled in a way that fits the experiences one has with one's body.

The claim is reminiscent of the idea of visuomotor congruity as characterised previously. Schubert goes on to cite evidence (Dourish, 2001; Glenberg, 1997) in support of a dual-process model of embodied cognition, whereby the activation of potential motor responses (actions) is triggered by unconsciously perceived affordances (bottom-up 'codings') as well as conative, goal-directed behaviour (top-down knowledge and/or beliefs about how to execute actions). Schubert's view of spatial presence as a 'cognitive feeling' reifies the subjective phenomenon as a type of *knowledge*, albeit erroneous knowledge in the context of VR: Unconscious sensorimotor processes aggregate perceptual information from vision, audition, proprioception, and other forms of sensation in producing the incorrect 'knowledge', belief, or momentarily-insurmountable, sub-personal conviction that one is located within a virtual space.

In concert, Wirth et al.'s 2007 process model and Schubert's 2009 characterisation posit spatial presence as a product of our embodied sensory survey of a given environment. The product of spatial presence is the sub-personal belief that one's self-location within a given environment is actual. Crucially, in certain contexts, this produces behaviours and/or affective outcomes *demonstrative of such a belief* (Slater, 2009). This is perhaps best exemplified in behavioural tests of spatial presence, where VR users duck to avoid projectiles or hesitate to approach sheer drops (Laarni et al., 2015). These behaviours indicate the activation of spatial presence in VR ('binary' and 'Gestalt-like' as it is; Slater, 2002; Wirth et al., 2007), since players do not behave this way when gaming on conventional, two-dimensional desktop displays or televisions—screens that do not typically confer a strong sense of spatial presence.

Affect and Emotion-Directedness

This treatment follows affective scientists James Russell and Lisa Feldman Barrett (1999; also Barrett, 2006) in differentiating between *core affect* and *prototypical emotional episodes*. For the purposes of this paper, core affect (hereafter just *affect*) is loosely distinguishable from prototypical emotional episodes (hereafter just *emotion/s*) insofar as affect is prerequisite to and largely determining of emotion. Affect is a snapshot of how one ‘feels’ at any given moment in time, which is reflective of our organism's continually fluctuating chemistry. Affect is ever-present, variable over time, and susceptible to spikes or other changes cued by endogenous *or* external stimuli. Affect is two-dimensional; it comprises a valence (positive/negative; approach/avoid) and some level of arousal (activation/deactivation) which, though produced by separate neural and autonomic substrates, combine to produce a single subjective affect. The startle response, for instance, is not an emotion per se, but it does accompany an aroused—and typically aversive—affective reaction. If the cause of a startle proves to be benign, one will soon return to a normal affective state (i.e., homeostasis). However, if the trigger of the startle transpires to be an actual threat, or heralds something deeply unpleasant, one's conceptual–linguistic appraisal of one's own affective changes (feelings) may cause the affective state brought about by the startle to persist, to be dwelt upon, and thus to qualify as constitutive of emotion proper. For instance, witnessing a serious traffic accident might produce a startled (affective) reaction followed shortly by the onset of a prototypical case of shock-inflected sadness (emotion proper).

Emotion, unlike affect, is an intentional state; it is *about* something in the world. Where affect can be hard to attribute, emotion necessarily has a clear object. Bernard Perron argues that in digital games, we can have emotions for (or, rather, *about*) different levels of the overall game experience (Perron, 2005). Fiction emotions (*F emotions*) are cued by diegetic events, and are construals of our concerns for and about characters' relations and situations. We align ourselves with different characters and, accordingly, have emotions for and about their goals and motivations. Gameplay emotions (*G emotions*), by contrast, stem from—and are about—our own experience of playing a game. *G emotions* are caused by and directed towards ludic elements such as game mechanics or other non-diegetic elements structuring the play experience (e.g. a countdown timer; a lack of checkpoints). Artefact emotions (*A emotions*) are about the game as an object; as art. We might have emotions such as joyful admiration for the game designers' and programmers' abilities, or, oppositely, berate their ineptitude. *A emotions* can also be meta-emotions inasmuch as they may describe the lingering, contemplative feelings that resurface when one nostalgically recalls one's prior emotional experience of a game.

The distinctions introduced on this page are consequential for the following reasons. As will be shown, when a VR stimulus is sufficiently salient, the scenario may demand automatic attention allocation and implicit (i.e., automatic) cognitive processing, which can cause the the player to momentarily ‘forget’ that they are controlling an avatar or role-playing as a character. In cueing affective reactions that are not ‘about’ storyline (*F emotions*), ludic elements (*G emotions*), or extratextual factors (*A emotions*), VR games highlight a potentially separable affective–emotional category to supplement Perron's three. *I emotions* is a term apt to capture the self-directed feeling of bodily or existential threat so easily cued in VR (Murphy, 2016). *I emotions* are pronounced in VR in that conventional screen-based games rarely (if ever) cause the player to believe that they themselves are in actual, immediate danger. The types of perceived, self-directed threat discussed throughout this paper are, to differing degrees, tied to our sense of bodily vulnerability and implicit drive for self-preservation. First-person console games might

startle us and make us panic, but mainly through the evocation of story-world or gameplay concerns—for instance, because we don't want our protagonist's love interest to be harmed, or because we don't want to 'die' before we reach a checkpoint. VR, by contrast, regularly and effortlessly elicits authentic-feeling, self-directed, affective survival concerns. This idea, borne from previous conceptual work and reinforced by the present study's primary thematic finding (patience), is reintroduced and discussed later.

METHODOLOGY

The study can be described as an exploratory, qualitative content analysis, inspired by systematic review. Rather than aggregating effect sizes, as would a quantitative meta-analysis, it examines the stimulus materials of past VR studies (i.e., immersive virtual environments; IVEs), coding formal features and content observed therein by means of thematic analysis (Braun & Clarke, 2006; Bryman, 2012) while also backing up observations and inferences with the findings of the primary literature.

First, a body of materials (research papers/abstracts and their related audiovisual media and appendices) describing or depicting VR IVEs used in clinical or otherwise experimental studies was selected ($n=124$). The IVEs themselves could not be experienced first-hand by researchers since the simulations date back as far as two decades and were mostly designed to run only on their laboratories' bespoke systems. Data were created and coded in the process of indexing what was taken to be the most perceptually and affectively salient features of each IVE for non-clinical populations. This first phase served to homogenise data taken from diverse types of source material (a contingency well-handled by the content analytic method; Krippendorff, 2004), creating a coded catalogue of IVEs and their assorted salient aspects. Secondly, formal–thematic analysis was conducted on the dataset. This type of qualitative content analysis has been referred to by some as 'ethnographic' in bent (Altheide, 1996), and by others as 'hermeneutic' (Mayring, 2014). Both descriptions emphasise the desirability of discovery and face (or social) validity over the rigidity of verification studies. Where traditional (quantitative) content analyses are sequentially linear and stress replicability, qualitative content analyses foreground utility and applicability though adaptability—they remain true to their interpretivist principles by employing reflective, reflexive, and cyclical coding techniques that acknowledge and even foreground the potential influence of a researcher's academic training and alignment. To further characterise the study's methodology, one might make reference to several hallmarks of the Grounded Theory (GT) methodology.

In keeping with certain conceptions of GT (Reicherz, 2007), three features can be observed. Firstly, the coding of data was sensitive to pre-existing theoretical constructs and interpretive frames. As mentioned, the present study is aligned with cognitivism rather than, say, psychoanalysis or cultural studies. This means that both sampling and coding was conducted with the aforementioned notion of universal, core cognitive structures and tendencies in mind (e.g. Grodal, 2003; Gregersen, 2014), rather than, say, concepts such as 'fantasy' and 'desire', or 'intended' and 'negotiated' readings. Secondly, sampling was cyclical, with a small number of ideal data objects being selected and coded before the search strategy was returned to and iterated until the sample reached saturation point (Bryman, 2012). Thirdly, the methodology drew comparisons between observed and inferred phenomena and *context* in validating its abductive reasoning. In this instance, this means that each observed feature of the sampled IVEs (e.g. an angry virtual dog; a claustrophobic space) can be related back to empirically-observed outcomes from the body of scientific literature which constitutes the bulk of sampled

documents. In other words, if several of the IVEs were observed to contain hostile virtual humans, with the researcher supposing that these virtual humans' proximity and intense gaze would be arousing and unpleasant for the VR user/player, this supposition was confirmed by the findings of the primary literature before being reported in the present (meta-)study. Thus the study draws from GT inasmuch as it seeks to unearth, through abductive reasoning, theories 'dormant in the data' (Strauss, 1994, quoted in interview; Legewie & Schervier-Legewie, 2004).

Sampling/Search Strategy

PubMed was queried using the search term 'virtual reality', yielding over 6000 results—an exponential increase from the 291 reportedly listed in 2008 (Riva et al., 2009). 'Virtual reality [and] emotion' yielded under 300 results; 'virtual reality [and] affect' returned 190 results. Similar searches were performed using *Scopus*, which returned many hits but few new materials. 'Virtual reality' was favoured over 'virtual environments' as the latter returned mostly screen-based trials that fell short of 'immersive', HMD-based VR. The archives of the journal *Presence: Teleoperators and Virtual Environments* were trawled, as were all thirteen volumes of *Annual Review of CyberTherapy and Telemedicine*.

Formal–Thematic Coding

Firstly, the content of each IVE was coded and catalogued. This produced an index of perceptually and affectively salient stimuli seen in the IVEs, which is reviewed shortly (*Findings: Typical Content*). These initial codes were transformed into a set of categories which, rather than describing content attributes (e.g. angry dog), outlined the formal aspects of stimulus presentation (e.g. angry dog → loud, sudden movement; surprising) that govern how entities are likely perceived. A framework describing the process of stimulus presentation and perception within the IVEs was thus developed relative to observed categories *and* in light of cognitive theories of emotional appraisal and experience. Consequently, the study's approach to thematic analysis can be considered both inductive and theoretical (both 'bottom-up' and 'top-down'; Braun & Clarke, 2006). This is deemed necessary and worth discussing openly, since in *no* study are data ever interpreted 'in an epistemological vacuum' (Braun & Clarke, 2006: 84). Details relating to the transformation of categories into a preliminary process framework for describing the perception and appraisal of IVE elements is recounted in greater detail shortly (*Findings: Towards a Framework*). The types of typical content encountered were then considered relative to the framework, by which it was induced that an IVE element must first capture a user's attention, be appraised as relevant to their concerns, then, in many prevalent instances, confer a sense of (simulated) physical or psychological patency, often as a result of the user being in a position of vulnerability or limited agency.

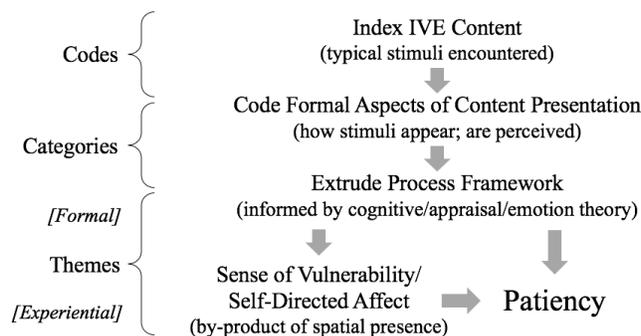


Fig. 1. Overview of thematic coding process.

FINDINGS

The following subsection outlines stimuli appearing frequently across the range of sampled IVEs. Groups discussed are *Human Agent(s)*, *Events* (or actions), *Ambient* features, and *Nonhuman Agents*. These are reported so that (A) readers may judge for themselves how closely the occurrences observed in sampled IVEs parallel typical, contemporary VR game content (thereby illustrating the relevance, face validity, and generalisability of the study), and (B) to show more explicitly and transparently what categories of coded data inform the study's analysis and conclusions.

Typical Content

Examples of *Human Agent(s)* include: Intimidating 'social acquaintances'; members of the public going about their business; expressively neutral virtual humans (often sustain mutual gaze/eye contact); conversational partners; dentists/doctors; doppelgangers modelled after the user; audiences of varying sizes and degrees of enthusiasm; nudes or prospective virtual sex partners; virtual agents playing the role of family members; children requiring assistance/advice; the user's avatar (seen in a mirror); squad members (in military contexts).

Examples of *Events* include: Tasks (such as shooting at targets or completing a puzzle); collapsing floors and other existential threats (e.g. smoke filling the room); sudden exposure to extreme depth cues (i.e., simulated heights; being forced to look over a canyon edge); threats to virtual humans (e.g. speeding vehicles); the death of virtual humans; aeroplanes taking off/landing; catastrophes such as vehicular terror attacks; gunfire/explosions (visible or audible); benevolent/malevolent acts by AI virtual humans.

Examples of *Ambient* features include: Pleasant weather; colourful environments; nature scenes (e.g. forests or tropical islands); birdsong; dark/night-time street scenes; untidy or dirty/disgusting environments; warzone 'ambience' (incl. but not limited to the sound of gunfire, explosions); a surreal (e.g. mutable, *Daliesque*) quality to the environment; generic 'horror' mise-en-scène (e.g. an old, dark, creaky mansion); spaces that feel enclosed or crowded.

Examples of *Objects* include: Food, cigarettes, alcohol, or other 'craved' items and their related cues; pictures, images, or photographs within the scene (e.g. hanging on the wall); vehicles; furniture or spatial features within a scene (e.g. a plant pot; a pit).

Examples of *Nonhuman Agent(s)* include: Spiders; snakes; sharks, insects, humanoid robots; dinosaurs; apparitions or seemingly paranormal forces.

Towards a Framework

Further extrusion of the themes latent in the content-categories listed above produced a preliminary framework in which (1) VR users' attention is captured by a stimulus, (2) curiosity, interest, or concerns are generated, and (3) user agency or *sense* of agency appears limited, or users are exposed to a situation in which evaluations of their own coping potential can be assumed to be low. The following paragraphs explicate the framework and show how it emerged from the data. Readers may again note that its processual structure—though not an *a priori* given—is informed by (and is therefore consistent with) broadly cognitivist accounts of affect-driven attention allocation (e.g. Lang & Davis, 2006), perception (e.g. Gibson, 1979), and appraisal (e.g. Frijda, Kuipers & ter Schure, 1989). This formal framework may contribute to a greater understanding of

user/player experience in VR as significantly coloured by *patiency* (cf. *agency*), co-occurrent as it with a sense of self-vulnerability. These findings, in concert with the subsequent discussion, should give prospective VR experience designers an idea of how best to avoid unnecessarily exposing the user or player to surprising, unpleasant, intense, discomfiting, or unsettling situations.

(1) **Capturing Attention:** First, attention must be drawn to a virtual object or agent. Factors influencing attention allocation include stimulus proximity, animacy, perceptual realism, and, relatedly, plausibility.

Proximity: A primary modulating factor in attracting and sustaining attention is perceived spatiotemporal proximity of a given object or agent. Consider a virtual building fire (Spanlang et al., 2007; Malbos et al., 2012). If the fire is immediately apparent, the stimulus is *visible*. In other situations, the fire is at first only *suggested* by the presence of an *indexical sign* (e.g. the user can see smoke filling the room). In some studies (e.g. Isnanda et al., 2013), paranoid thought is induced in users by the mere *suggestion* that a terror suspect could be loitering nearby. This constitutes a *possible* stimulus. Even when a stimulus is not physically proximal, users' expectation that it may soon appear is clearly enough to cue psychophysiological arousal. With regard to AI virtual humans (especially those that maintain mutual gaze), it is repeatedly found that users' arousal and emotional memory fluctuate with proxemics, just as in reality. When embodied virtual agents stand close to human users' avatars, skin conductance increases; arousal intensifies; people become uncomfortable or anxious (Bailenson et al., 2001; 2003; Wieser et al., 2010; Åhs et al., 2015; McCall et al., 2015; Tremblay et al., 2016). Proximity is also seen to enhance the affective salience the time-tested VR 'pit demo'. When users stand close to a sheer (virtual) drop, heart rate increases, skin conductance rises, and the visceral sensation of vertigo often takes hold (Meehan, 2001). The effect is especially pronounced when participants are made to stand on a plank of wood which mimics the virtual gangway, providing haptic feedback—this makes the feeling of standing on a narrow ledge all the more convincing. An affective stimulus' potency is seemingly amplified by its perceived spatiotemporal proximity.

Animacy: Closely related to the notion of stimulus proximity is 'vitality' or 'animacy'. This can manifest in relation to agents, objects, or environmental features. Virtual agents, whether human or non-human, can exhibit varying levels of animacy. That is, their tendency to move and act as a result of user action (input) or wholly independently. In the instance of virtual agents, animacy can attract attention initially and involuntarily, as well as helping to maintain attention via interest. Subtle examples of virtual agent animacy include eye movements (blinking or surveying, as well as holding mutual gaze). More pronounced examples include AI virtual humans sprinting through a scene, connoting suspicious behaviour in combat training simulations, building fire scenarios, or terror threat training/therapy.

With regard to environmental features, data from several of the sampled items revealed a curious factor: *environmental instability* as seemingly confounding users' implicit expectations of *object permanence* (Piaget, 2000). Numerous sampled IVEs (esp. all four scenarios in McCall et al.'s *Wunderkammer*, (2015), as well as the *Surreal World* scenarios from Gutierrez-Martinez et al., 2010, and Hoyus et al., 2012) feature morphing, semi-incoherent environments that defy normal logic and expectation. A deduction supported by findings from the literature is that such unpredictability of environment can pique users' curiosity and may maintain attention independently of affective valence.

Perceptual realism: Though it cannot be precisely stated to what extent users' assessments of verisimilitude factor into reality status judgements, it can be broadly asserted that perceptually realistic environments are more likely to lead to incorrect appraisals of IVE authenticity by incurring higher cognitive processing costs. In other words, it takes longer to correctly identify perceptually realistic stimuli as *not-real*. Perceptual realism can be assessed independently of situational plausibility, as with the case of visually convincing but impossible encounters (e.g. with dinosaurs or dragons).

Plausibility: Users' assessments of whether or not a novel situation is real entails implicit judgements interacting with more conscious top-down knowledge and expectations. A user's assessment of plausibility may include judgements on whether an object or event is consistent with its environment, as well as with preceding events. Top-down assessments can include whether or not the witnessed scene is typical of real life; whether it has a real-world correlate.

(2) **Generating Concerns**: Concern here refers not to feelings of anxiety, but rather the intentionality ('aboutness') of emotional appraisals. As discussed earlier, emotions necessarily concern (i.e., are about something) in the world. Moreover, if the object of concern bears no relevance for the individual, there will be no emotion (Frijda et al., 1989). The concerns upon which emotional responses are predicated can, as mentioned, be generated by—and directed towards—different levels of VR gameplay experience. Here, observations and inferences relating to appraisals/emotional concerns are presented per Perron's taxonomy (following Tan, 1996) for game emotion.

Diegetic concerns (F emotions): Many IVEs or VR scenarios are given narrative elements, or are preceded by blurbs or instructions from the developers or researchers that aspire to lend structure, coherence, consistency, believability, or gravity to the scenario. Such background information necessarily frames the concerns that emerge in users' perception and appraisal of IVE elements. Examples of diegetic concerns scaffolded by scene-relevant fictions include having to save children in peril (Rosenberg et al., 2013), choosing whether to be responsible for the death of one virtual human or five (Navarrete et al., 2012), being a bystander to an emotional and violent incident (Jouriles et al., 2016; de la Peña, 2014a; 2014b; 2014c), or having to watch vehicles hurtle towards innocent people while not possessing a means by which to intervene (Malbos et al., 2012).

Simulation concerns (G emotions): These concerns might relate to users' experience of embodying an avatar, manipulating objects in the virtual world, and the response of simulation mechanics, including embodied virtual agents. Also included is users' self-appraisal of task performance.

Artefactual concerns (A emotions): Closely related to the simulation level, the artefactual level supports concerns and meta-emotions pertaining to users' experience of material and formal system features. This could include awe at the recognition of exquisite graphical rendering, or frustration at an ill-fitting HMD.

Self-directed concerns (I emotions): Data from the sample reinforce the idea that self-directed concerns in VR, rather than being meta-emotions about one's experience of narrative events (e.g. 'I really enjoyed crying over that game's ending'), might refer to affective outcomes that manifest precisely because the user momentarily fails to consciously recognise that an aspect of their experience is virtual. A prime example of this is the hard-to-dispel fear that one is overcome by when confronted with a virtual pit

or drop. Self-directed concerns fostered by spatial presence can co-occur (ISPR, 2000: §1) with the rational knowledge that one is *not* in danger. That is to say, it is possible to *know* (to consciously believe) that one is safe, yet simultaneously experience inexplicable visceral fear at one's apparent closeness to a lethal (virtual) drop. Similarly, it is possible to 'know' that a depicted avatar body is not one's own physical body, yet still flinch or withdraw when a knife or some object threatens an appendage such as a virtual hand (Yuan & Steed, 2010; Ma & Hommel, 2013; González-Franco et al., 2014).

(3) **Limited Agency:** Users' in-world agency is prescribed by and constituted in both hardware and software. The coupling of input channels (whether motion-tracked or gamepad-based) with possible virtual actions is what bestows discrete agential affordances in VR, such as the ability to reach out and open a door by its doorknob. If users' hands are not tracked as input, gaze control may enable them to turn doorknobs. Alternately, the simulation may not support such abilities at all. In immersive VR, users can often be seen to attempt actions that are not possible in the simulation, such as attempting to kick a virtual ball when only their head and hands are motion-tracked. Data analysis strongly suggests that limiting agency in VR is relatable to inducing or evoking *patiency*. That is, positioning the user as a passive recipient of virtual (simulated physical) or psychological battery.

Inability to (re)act: Negative affect and anxiety are seen to be triggered by a number of events in the sample. The inability to resist violent virtual humans or animals, to retreat, or to avoid oncoming vehicles all represent forms of virtual *patiency* by *limited agency*.

Guilt/culpability: Several of the sampled IVEs entail moral conundrums wherein a preordained inability to take effective action results in the user having to question their moral appraisal of the situation. This can be considered psychological *patiency*, and is closely related to the above idea of inability to exercise agency; to take effective action.

Freedom–containment–confinement: Users' ability to move freely within a virtual environment (or not) is also likely determining of the experience of agency and *patiency*. *Freedom* is posited as when the boundaries of an environment are so distant that the user feels able to explore uninhibitedly. *Containment* is when the boundaries of the environment are made explicit in an attempt to make the user aware of spatial limitations placed upon them. *Confinement* occurs when the IVE anchors the user to the spot, or conspicuously introduces barriers to evoke a sense of enclosure or entrapment.

DISCUSSION

Here, claims are made for the value of examining VR player experience from the conceptual–experiential standpoint of *patient*, highlighting as it does the subjectively vulnerable position that VR gamers may find themselves in when experiencing vibrant, often hostile gameworlds from the novel, verisimilar viewpoint afforded by the material VR system and its perspectival idiosyncrasies.

Patiency (cf. Agency)

Patiency is an etymologically archaic term for suffering. Though still uncommon outside of linguistics and philosophy of action, it is nowadays used to describe the thematic relation between an agent and its target (OED, 2016). A cognitive approach within game studies has noted the role of patients in conventional digital games' canonical event structure of simulated force transfer (Gregersen & Grodal, 2008; Gregersen, 2014b) as well as denoting a player's in-world vulnerability (Vella, 2016; Klevjer, 2012). In the

context of most action–adventure, fighting, and shooting games, a player's exposure to patency is more or less counterbalanced by their access to agency. The *to-and-fro* of action exchanges in conventional digital games can be described as relatively symmetrical relationship between player and AI, or player and player. In VR contexts, it can be argued that the concept of patency may sensibly extend to perceived disruptions to an embodied player's affective state, and need not refer exclusively to the shooting and melee of virtual force transfer. *In this way, we might view patency as occurring whenever a VR game—through the use of perceptual cues; movement, scale, contour, colour (and so on), and enhanced by narrative or scene-relevant fictions—manipulates virtual objects and agents so to make the player feel exposed, uneasy, or overwhelmed.* Moreover, it is noted that the relationship between patients and agents in VR is seemingly far less symmetrical than in conventional digital games, with the often-helpless VR patient left feeling exposed owing to their lack of motion-controlled input. Arguably, this is at present a by-product of technological limitations manifest in sampling bias; few of the VR experiences examined employ full motion control, the hardware for which is (and will be) increasingly supported by consumer VR systems. As more VR games take advantage of hand-tracked or full-body motion control, player action or agency will likely become a more prominent feature of gameplay, necessarily de-emphasising the role or experience of patency. Yet the ability to ‘fight back’ does not detract from the fact that the bodily presence lent by immersive, first-person VR can foster strong bodily reactions as an indirect consequence of perceived bodily vulnerability. Nor does the ability to exert agency detract from the psychological impact of game scenarios in which one is suddenly left defenceless. Consider, for instance, the impactful scene in *Call of Duty 4: Modern Warfare* in which the player's evacuation helicopter is downed by a nuclear explosion, with the player forced to crawl around futilely while succumbing to radiation poisoning. That the player has, up to this point, grown accustomed to liberally exercising agency by means of weapons does not detract from the sudden switch to a position of overwhelming patency—on the contrary: this enhances the scene's emotional salience.

Players' Bodies as Sites of Feedback

In conventional screen-based digital games, the avatar is a player's virtual tool controlled in distal space (J. Waterworth & Riva, 2014). This statement holds regardless of whether the game is played from a first- or third-person perspective; the avatar is a proxy for action with its own distinct virtual body. In 1PP VR, however, the avatar serves in a more literal sense as a surrogate skin for the player to act within the virtual world. The VR avatar's first-person, egocentric viewpoint is lent an often-insurmountable sense of verisimilar functionality by the system's preservation of true-to-life depth cues and the naturalistic visuomotor congruity of accurate head-tracking across six degrees of freedom (i.e., forward/back, up/down, left/right, pitch, roll, and yaw). Thus, in offering a strong sense of spatial and bodily presence, contemporary VR can shake, rattle, and startle users. This is a natural by-product of presence technologies, whereby, according to the International Society for Presence Research (ISPR, 2000 – *emphases original*):

[E]ven though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience. ... [A]t *some level* and to *some degree*, her/his perceptions overlook that knowledge, and objects, events, entities, and environments are perceived as if the technology was not involved in the experience.

Crucially and evidently, spatial presence experiences by means of virtual embodiment enable players' organic, feeling body to be stimulated by on-screen events. Writing on the

applied ethics of VR, Michael Madary and Thomas Metzinger (2016: 14) describe this as ‘bidirectional control’, and, in their terms, the phenomenon denotes players’ bodies being *causally paired* with corresponding aspects of the environmentally-embedded avatar body. Thus, in VR, the player’s body is a meaningful and easily-accessible site for delivering feedback, for instance in the form of dizziness and visceral unease (or, less dramatically, ‘butterflies’, as in vertigo; Blascovich & Bailenson, 2011) or musculoskeletal reflexes. Specifically, this study has cited evidence that threats to a VR user’s adopted avatar body can elicit strong withdrawal reflexes (Yuan & Steed, 2010; Ma & Hommel, 2013). (Contrast this with the timid vibrotactile feedback of the humble *Rumble Pak* or *DualShock*.) Additionally, proxemic effects (personal space in social situations) are preserved in VR, meaning that users experience their avatar’s peripersonal space as their own (Bailenson et al., 2001), with this fact reinforcing the idea that IVEs are surveyed in a manner that is perceptually and cognitively analogous to real-world vision and audition. For emphasis, it is worth restating that virtual humans standing too close to VR users can be experienced as uncomfortable or distressing—just as in reality—and, oppositely, that an attractive virtual human approaching VR users in an intimate manner can occasion a blush response (Pan et al., 2008) or stronger signs of attraction (Renaud et al., 2002). Thus even when no simulated force transfer occurs, VR players can be made to physically and literally *feel* something that the game designer wishes to communicate. Moreover, in social VR games populated by human-controlled avatars (in some instances, children; *Against Gravity*, 2016), the implications of personal space and perceived personal autonomy are even more pronounced. One need not recount the transgressions of ‘Mr. Bungle’ in *LambdaMOO* (Dibbell, 1993; Madary & Metzinger, 2016) in order to highlight the potential risks of embodied social interaction in VR.

The notion of the player’s body being interpolated into the gameworld is also worth considering relative to Daniel Vella’s recent taxonomy of ludic subjectivity and subject-positions (Vella, 2016). He argues that Ulf Wilhelmsson’s (2008) concept of *game ego* cannot be equated to ‘phenomenological embodiment in the gameworld’ by means of ‘cognitive incorporation’ into an avatar (Vella, 2016: 2), as Wilhelmsson’s writing permits the concept to extend to apparently disembodied positions such as that offered in and by *Tetris* (Pajitnov, 1989). To add clarity and utility to the dual notions of subject-position and ludic subject, Vella suggests that the former—rather than being directly equatable to a perceptual standpoint—describes ‘an experiential Gestalt resulting from the aggregation of a set of formal mechanisms structuring the player’s engagement with the gameworld’. Further to this, for Vella, the ludic subject is ‘a self that is distinct from her [the player’s] own identity as a playing individual outside the gameworld’, and ‘the ludic subject must be maintained as clearly conceptually separate from the diegetic character on the one hand, as it is separate from the player as an actual individual on the other’ (Vella, 2016: 3).

Yet the boundaries between player and character—between the subject-position offered by a given avatar and the player’s separable subjectivity—are evidently not so sharply drawn in VR. As has been shown, VR simulations are prone to present elements of the gameworld (be they objects, agents, other entities, or events) to players in such a way that the ‘experiential Gestalt’ scaffolded by the simulation media is significantly coloured by the pre-rational, unconscious, or sub-personal conviction that certain diegetic elements or entities have the ability to act upon the player *as though real*. In these instances, the insentient avatar is not primary patient to the actions of the game(world); the player herself is the primary patient, with the visceral unease of vertigo, the proxemic discomfort of space-invading virtual humans, and reflex-like shocks and startles that

accompany perceived threats to our body serving as evidence that a ludic subject and her affective experience are not so separable after all. Thus in future theoretical treatments, it might be apt to entertain some form of dual-process view whereby accessible, deliberative, ‘top-down’ cognitions seek permit the player to maintain the separation between subject–position and individual self, while low-level visual features belonging to objects and agents in the VR gameworld cue stimulus-driven (bottom-up), ‘hot’, or affect-laden cognitions that dupe us into *feeling*—though perhaps not fully believing—as though we have an embodied presence in the virtual environment; that we are our avatar or, rather, that there is no avatar. This, as has been argued, is made possible foremost by the system's preservation or, rather, precise reduplication of our everyday perceptual experience; by spatial presence.

CONCLUSION

In surveying VR environments alongside others' findings as to their outcomes and effects, this study has aggregated evidence in support of (and hopefully substantiated; extended the generalisability of) the common-sense claim that VR ‘feels more real’ than traditional screen-based games. Rather than simply restate this notion, however, this paper has aimed to show—through thematic analysis and theoretical induction—how VR players' embodied presence may be leveraged by the simulation. It has been argued that VR games can present attention-grabbing stimuli that are relevant to players' relationship to diegetic events, aspects of a task or gameplay, artefactual (system) factors or meta-emotions, and, somewhat novelly, self-directed concerns. Specifically, it has been suggested that as a consequence of presence—as a result of VR systems eliding their own role in the simulated experience—users or players can feel that *they themselves* (not their avatar, character, or proxy) are patient to the agency of actors, objects, or events within a VR gameworld, thus hinting at a category of game emotion perhaps not subsumable under existing taxonomies.

As VR gaming systems edge into the repertoire of both casual and ‘hardcore’ demographics, a greater understanding will be required of how VR as an interaction paradigm both constrains and enables new forms of perceiving, cognising, experiencing, and interacting with ludic content. The findings of this exploratory (meta-)study happen to be highly concordant with those of Google's VR user experience team, whose cautionary advice about the formal qualities of VR environments was dispensed at a developer conference discovered by the author *after* the completion of this paper (Google, 2015; 2016). (Indeed, readers interested in a more design-oriented set of rules and observations regarding player or user experience in VR are referred to these Google sources, as they also suggest best practices for user interface design and so forth.)

Future investigations into player experience in VR—whether theoretical or empirical—should ideally proceed with reference to published VR games, and preferably support their claims with data taken from *in vivo* player observation or experimentation. In choosing to sample not games per se but, rather, simulations developed using game engines for historical clinical or academic purposes, this study has appealed to and integrated a corpus of research and literature that is not only apposite to our objects of interest, but that was also at risk of having been overlooked by humanities scholars. Separately, it is worth suggesting that future theoretical treatments should reference the interacting roles of body *schema* and body *image*—helpful cognitive and philosophical ideas that this paper has not had space enough to meaningfully incorporate into its discussion.

As with conventional digital games, VR games are already being used for rhetorical or persuasive purposes (see the wildly contrasting depictions of Donald Trump in *Wide Awake*; MacInnes Scot, 2017 versus *President Erect*; Lines, 2016). Digital games, needless to say, can embody and express ideas, values, and norms. It is thus imperative that game studies researchers engaging with both the social sciences and the humanities stay abreast of technological developments in continually seeking to understand how the affordances of new hardware apparatuses may structure the public perception and practice of relationships, gender roles, community, commodity consumption, nutrition, empathy, violence, and even game media consumption itself.

The notion of patiency in VR as presented in this essay—though by no means a singly sufficient theoretical tool for explaining the workings of VR gaming at large—sheds some light upon a few of the structures and conventions that shape user or player experience in early consumer VR. Hopefully this foray into unfamiliar territory is taken as timely, and serves to pique the cross-disciplinary field's interest and keep academics attentive to a number of potential issues relating to the role of mediated, embodied virtual experience in shaping the mind.

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