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BACCHUS, Daniel

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Articulating a post-human understanding of presence in virtual reality

Daniel Bacchus

Faculty of Arts, Computing, Engineering and Sciences
Sheffield Hallam University
Sheffield, England
d.bacchus@shu.ac.uk

Abstract— **This paper critiques existing methods and experimentation that use virtual reality (VR) and associated technologies to define and measure 'presence'. Relevant contemporary philosophical resources are used to critique and reframe existing research, introducing a new post-human perspective on presence. Here, a new methodology is built as a foundation for research methods used for capturing subjective, experiential data and to contribute to current thinking around experiential design for VR.**

Keywords—Virtual worlds vs virtual experiences; Context specific virtual worlds; Digital art; Virtual reality; Post-human philosophy; Experiential design; Presence

I. Introduction

The International Society of Presence Research defines presence as 'a psychological state or subjective perception in which even 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' [13]. Other notable researchers define presence as 'a normal awareness phenomenon that requires directed attention and is based in the interaction between sensory stimulation, environmental factors that encourage involvement and enable immersion, and internal tendencies to become involved' [25] and 'as the propensity of people to respond to virtually generated sensory data as if they were real' [20]. Research designed to capture data relevant to these definitions use a variety of methods, including questionnaires [25], the measurement of physiological responses [16] and neuro-analysis [3, 4].

When critiquing this approach, a range of philosophical perspectives relating to presence will be drawn from, including Merleau-Ponty's 'phenomenal field' [17], Dewey's 'Experience and Nature' [9], Deleuze's 'Difference and Repetition' [5] and Harman's 'tool-being' [12]. Here, a post-human position on presence is established; one that critiques self-sovereignty and embraces intra-actional [2] understandings of co-equal relationships between subject, material and virtual objects. The continued significance of selfhood via embodied experience, and how VR can contribute to this understanding, is explored. The paper addresses philosophical perspectives on the 'real' and the 'virtual' and whether it is possible to substitute one for the other, or could VR rather be used as a tool to reframe habitual understandings of both.

The methodology and active/reflective research process outlined draws from Deleuze and Guattari's 'speculative experimentation', whereby 'experimentation is always that which is in the process of coming about – the new, remarkable and interesting that replace the appearance of truth' [6]. Where Deleuze asserts that difference is primary, presence can be perceived as a continual (re)creation that consistently evades capture and measurement.

Finally, the paper considers how immersive digital technologies can be used to build VR models further exploring new understandings of presence, and suggestions for how the potential boundaries of presence and selfhood within virtual environments can be explored through practical experimentation. Habitual, representative notions of self, environment and the relationships between them are bracketed, with VR design instead approaching what Deleuze calls the 'extra-propositional or sub-representative problematic instance'; an image of thought 'which traverses the fragments of a dissolved self as it does the borders of a fractured I' [5]. The mind-body-world separation in existing research is addressed, drawing from Dewey's interpretation of 'body-mind', where 'the anomaly apparent in the occurrence of consciousness is evidence of the anomalous phase of nature itself' [9]. New insights are proposed outlining how immersive digital technologies can be used as practice-based tools to explore current questions around presence, experience and selfhood within contemporary theoretical and philosophical disciplines in innovative ways, and inform further innovations in experiential design.

II. Current Presence Experimentation

The following section examines existing research taking various approaches to the measurement of presence using VR technologies. Research methods and the interpretation of results are critiqued, highlighting some of the inherent complexities that appear within these approaches to presence.

A. Presence in Real and Virtual Worlds

In a critique of the use of questionnaires as a data collection method in presence research, Usoh, Catena, Arman and Slater

indicate that 'if presence is optimal for real-world experiences then methods that attempt to elicit or measure presence should be able to discriminate between experiences that take place in a physical environment and virtual environment' [24] (see also [19]). The researchers undertook an experiment whereby participants completed an object finding exercise in a real and virtually simulated version of the same environment. Participants answered two presence questionnaires (the Witmer and Singer Presence Questionnaire (WS) [25], and another developed by Slater and colleagues (SUS)), attempting to ascertain whether the presence measure could pass a 'reality test'. This was determined 'if the measured presence is greater for the real environment, under today's conditions, and for the foreseeable future' [24]. Results indicated that, as the SUS questionnaire only scored marginally higher for the real environment versus the virtual, and there was no significant difference across environments for the WS questionnaire, 'that though such questionnaires may be useful when all subjects experience the same type of environment, their utility is doubtful for the comparison of experiences across environments' [24].

The conclusions drawn from this experiment highlight some of the complications that arise when a single definition and measurement for presence is used across different participant experiences. However, there are a number of additional factors with the experiment design, data collection method and interpretation of results not specifically targeted by the experiment that contribute to this complexity.

Firstly, although the VR environment used in the experiment was designed to resemble the real environment, there are marked differences between the two experiences that will fundamentally alter the virtual experience for the participant; including but not limited to colour, quality of textured surfaces, lighting, sound, tactile quality and the lack of many other auxiliary sensations and experiential factors that cannot be simulated by the VR hardware used.

Secondly, the questionnaires do not offer the participant the opportunity to reflect on their interpretation of the targeted factors in sufficient detail, nor do they consider factors with sufficient rigour. The SUS questionnaire is designed to target three main themes; 'the sense of being in the VE, the extent to which the VE becomes the dominant reality, and the extent to which the VE is remembered as a 'place'' [24]. The questionnaire required participants to indicate on a seven-point scale to what extent their experience 'seemed like the reality' for them, and later to compare the structure of their memory of the experience 'to the structure of the memory of other places you have been' [24]. The questionnaire presupposes that each participant has an identical understanding of what is considered to be an adequate measure of reality and structure of their memories, applied with an equal capacity for deciding this measure on the scale. The concepts around perception of reality and the structure of memory are very deeply complex. Elements of these could be considered from many different scientific and philosophical interpretations before they are defined and applied to an experimental setting.

From the above examination, it is argued that the two experiences featured within the experiment cannot be compared to measure presence in this way. As well as highlighting that comparing results from the same presence measures across different experiences is problematic, the experiment further highlights that it is unlikely that presence can be universally measured across single or multiple experimental settings at all. VR technologies are not sufficiently technologically advanced to comprehensively simulate the full range of interconnecting events and experiences that form the full spectrum of presence in reality. Even if it were technologically possible to produce a comprehensive multi-sensory experience that completely isolated the participant from their experience of reality, attempting to implement a universal presence measure across this and 'real' experience would still raise issues. That is not to say that it is impossible to experience presence in its fullness whilst engaging with VR. Presence is not a feeling that can be quantified on a scale, diminished by the impoverished sensory quality of VR. Both the experience of reality and whilst engaged with VR are events in which the complete presence process occurs. Presence can be argued to be a continuously engaged process that consists of the totality of all aspects of the event in co-dependent relationships. The event of experiencing the real and the virtual worlds both elicit presence, but these are different presences.

Furthermore, the experiment does not adequately address the differences and complexities between events and experiences that can occur between different participants, at different times and in different environments. It cannot be presumed that there is a universal human capacity for perception, judgement of reality and memory structure independent of the event that can be used as a benchmark for measuring presence across different experimental settings. As will be outlined in more detail below, a particular presence, as reflected upon, can be seen as a complex emergent phenomenon with dependencies and relevant factors that fluctuate according to the changing interactions that take place within the process. The individual participant that senses and experiences, along with all the dispositions, interests, fluctuating attentions, thoughts and diversions, are not outside of but rather constitute their experience to reflect upon. It is this in its fullness that constitutes the presence that the SUS experiment questionnaire attempts to target. This experience is very complex and completely unique to the individual participant and the real and/or virtual objects they are engaged with. An identical VR experience engaged with by the same participant at a different time would produce another new presence as their thoughts and attentions fluctuate once more. It is necessary to acknowledge these considerations in order to avoid issues that accompany the presupposition of a universal model of understanding and potential measure of presence.

B. Physiological Measures of Presence

An alternative approach to presence measurement targets physiological responses to stressful virtual environments. An experiment undertaken by Meehan, Insko, Whitton and Brooks exposed participants to a virtual environment featuring

a deep pit which users are invited to stand at the edge of. During the experiment, a measure of physiological responses; skin temperature, heart rate and skin conductance, were taken. In a variation of the experiment, a 'passive haptic' element was introduced in the form of a 1.5 inch high wooden platform, positioned to coincide with the location of the virtual pit. As a measure of validity, the University College London presence questionnaire (UCL) [22, 23] was implemented. The experiment hypothesised that 'to the degree that a VE seems real, it would evoke physiological responses similar to those evoked by the corresponding real environment, and that greater presence would evoke a greater response' [16].

The results found that a change in heart rate satisfied the requirements for the hypothesised measure of presence. The addition of the passive active element increased the reported measure of presence even further. This experiment differs from the previous one highlighted in that it focusses on involuntary responses rather than on conscious reflections of presence. It also incorporates the active presence of additional physical objects within the experiment. Aside from featuring similar presuppositions regarding universal participant capacity for response, the experiment highlights further complexities around what the presence of additional objects within the process are or could be in relation to the participant, and how they in turn affect the participant.

For a participant, fully engaged with the VR experiment and experiencing a sufficient level of anxiety as indicated by their measured physiological response, the 1.5 inch wooden platform is no longer what it could be perceived to be in the 'real' world. Results showed that this element 'significantly increased' reported presence and is therefore argued to be a significant factor in the intensity of the event overall. Here again, it is the individual participants perception and disposition that is targeted as a measure of presence.

Within this experience, the presence of self and that of relevant objects within the environment generate identities in intra-actional relationships. The reality of the passive haptic element is no longer a small wooden board for the participant, but rather is the edge of the pit itself, potentially signifying significant risk or danger of injury or death. In other cases, it may signify a moment of exhilaration, or may insight complete indifference. These often compound, overlapping sensations, developed co-dependently by the objects and the participant, become factors of the presence process in their own right. The object is no longer as it could be objectively known, but could rather be seen as a locus for complex intra-action of sensations and subjectivities. As with identity, these factors also undergo continuous variation. The same can be said for purely virtual objects featured in the experience that are not supplemented by tactile stimulus. What results is not simply a virtually simulated object that stands as a substitute to resemble an object in reality, but a completely new, separate and real object with equal significance and relevance to the presence process as that of one encountered in reality.

This highlights the malleability of meanings, identities, significances and relevancies of objects within the presence event. The experiment also demonstrates that an objects

identity does not pre-exist the intra-action that develops it. The identity, significance and potential instrumentality of objects are not fixed in real or virtual worlds. Whilst an object experienced will be a certain way for one participant, for another it will be different. Repeat engagement with objects will further alter their presence as new events and significances emerge. Non-humans engaged with their reality will generate entirely different configurations of presence. The presence of self and an understanding of physical and mental states is generated by their relation to the environment itself. Simultaneously, the identity and significance of the environment is developed in a wholly unique way in relation to the individual self. This complexity makes universal measures of presence even more problematic. However, by overlaying parts of experience with virtually simulated stimulus in VR, it may be possible to deliberately manipulate the identity and meaning of objects, self and their significances. The ability to use VR to manipulate presence in this way presents an opportunity to gain greater insight into how meaning and presences are developed.

C. Body Ownership and Neuro-analysis

Presence research has featured the use of neuro-analytic processes based on the concept of the 'minimal phenomenal self', with constituting factors defined by Blanke and Metzinger as 'a globalized form of identification with the body as a whole…spatiotemporal self-location and… a first person perspective' [4]. Experimentation features a simulation of the phenomena of out of body experiences and autoscopy using VR in order to manipulate feelings of body ownership and first person perspective. This has also been combined with simultaneous real world tactile, measurement of physiological response and the use of questionnaires [3, 21].

Research undertaken has found that a transfer of body-ownership from the self to a virtual avatar is possible. Results from the Slater, Spanlang, Sanchez-Vives and Blanke experiment indicated that simultaneous tactile stimulation and a first person perspective were important factors in generating a body transfer illusion in the place of the participants own body. The researchers speculate that 'sensorimotor contingencies endow 'place-ness' to virtual space and the objects within it… When the virtual body is perceived to be in the same place as where the real body should be, perhaps this provides overwhelming evidence for the brain to generate the illusion that the virtual body is one's own' [21]. Other experimentation has utilised the same factors to generate a reported sense of body ownership away from the location of the first person perspective [10, 15].

This research highlights some important factors that can contribute to a developing sense of body ownership and the centring of what is regarded as self within human experience. However, these factors, taken in isolation, do not adequately contribute to a discussion of presence in its fullness. Whilst research may be able to identify factors relevant to the perceived locus of experiences for human subjects, this says little about how the body is understood in its instrumentality and its relationship to experience within the environment. In order to understand the body, it must be experienced within

the context of its potential interaction with the environment as a whole. A sense of agency is important here, and as other research has shown, it is also possible to use VR technologies to extend agency and body ownership to avatars that do not conform to the body as it is habitually understood, causing participants to perceive the self differently [1, 14, 18]. This reinforces the comments previously made on the indeterminate and fluctuating nature of the self and environment within presence, and the ability to use VR technologies to manipulate this in the process of its development. As has been shown, neither the self nor the environment are independent of the event of presence, both are equally dependent on each other in generating their identity and their potentialities for being and interaction within the event. As time passes and interactions take place these identities can change, as co-dependent relationships between objects within perception are enriched and others diminished according to the situation.

Ultimately, the only tool a human participant has at their disposal to experience presence is perception. Through experimentation using VR, some of the fundamental factors deemed relevant to presence, when perceived, have proved to be far from fixed and measureable. This view of presence makes traditional research methods challenging to implement, indicating that a new methodology would be beneficial.

III. PHILOSOPHICAL PERSPECTIVES ON PRESENCE

Current presence research highlights a number of factors that may be relevant to a particular definition of presence within a specific context. However, presence itself cannot be comprehensively understood from a purely human-centric perspective; an understanding of presence taken holistically requires that the presuppositions that follow the adoption of a universal model of a perceiving human self is abandoned in favour of a non-hierarchical, intra-actional model of all aspects of reality. The following section considers the works of various philosophers who have written on the subject of the body, self, the environment, time, learning and the relationships between these, in order to articulate a post-human standpoint and methodology on presence research.

A. Graham Harman – Object Oriented Ontology

Contemporary presence research has shown that an individualistic and human-centred standpoint on presence disregards much of the complexity of the presence process. This could stifle the opportunity for a richer understanding of presence; revealing insight into the intra-dependence and vibrancy of collective realities, and the potential for a deeper level of empathy for various forms of being.

Working towards a post-human model of reality, Graham Harman uses Heidegger's section in 'Being and Time' on the analysis of tools to describe the emergence of being between all objects as a non-hierarchical system of exchange. Within Harman's 'Tool-Being' [12], all objects are regarded as forms of equipment that bring forth the individuality and variable reality of themselves and all other objects. Objects do not exist as absolutes in reality, nor do they pre-exist the relations that form them. What emerges here is a view of the world as 'an infrastructure of equipment already at work, of tool-beings

unleashing their forces upon us just as savagely and flirtatiously as they duel with one another' [12]. Beyond what a human observer may understand as their reality, there is a vast and complex network of being taking place, with much of it 'unknown to us, and… certainly not invented by us' [12].

Harman describes this amorphous reality as 'the totality known as world' [12]. This reality does not conform absolutely to any specific context or world model; 'every being is entirely absorbed into this world-system, assigned to further possibilities in such a way that there could never be any singular end-point within the contexture of reference' [12]. Far from providing an objective, exterior view of reality, human perception and the presence that emerges 'does not stand as a simple finality, but gains its meaning only from an ulterior series of possibilities upon which it is projected' [12].

The actuality and individuality of objects that emerges in human understanding is not final. But, furthermore, it is not the relationships between these actualities as they have been understood by contemplative humans in which some of the primary presence-making processes occurs. Underneath this surface, representative view of reality, being and beings operate in myriad interactions and configurations. For Harman 'there is no such thing as a 'horizon', but only a system of exchange between beings and their being… The primary dualism is not between the thing and its ground, which is Dasein's own personal problem… Rather, the key dualism is the one between the tangible contours of all such entities and the mute system of actuality into which they withdraw' [12]. These 'tangible contours' operate as a 'real affect within the cosmos, an autonomous reality unleashing its forces upon the world quite apart from Dasein's projections' [12]. The relations and events that take place are the individualities themselves. Each individual intra-action, not only between human and non-human entities but between all entities interacting and individualising each other everywhere at all times, make specific contexts, and the systems that can be understood, possible. Presence for a human observer is just one possible context amongst an infinity of others, and its development is only possible within this system.

The 'ontological drama of reality vs. presence' [12], that results from the duality of being as observed from a human-centric perspective, is at the heart of some of the issues highlighted above. To view non-human entities as 'unproblematic lumps of matter' [12] is too narrow when considering presence in its totality. Some events may be deemed inconsequential whilst reflecting from a particular standpoint. Despite this 'they still exert their reality within the total system of entities… Any measurement or direct vision of them… will always be dependent on their primary reality as tool-beings' [12]. The non-hierarchical system of exchange that has been developed here reframes presence, outlining a sub-representative, pre-individual process in which the status of entities, self or otherwise, do not pre-exist or develop outside of the relations and interactions which form them. Entities are intra-actional events, and no specific context or perception can exhaust the potentialities of their being.

B. Merleau-Ponty – Phenomenology of Perception

The model of reality described above provides the foundation for developing a post-human methodology for presence. However, applying this approach within practical experimentation utilising human perception requires a more detailed examination into how the emergence of self could be possible within the philosophical framework.

The case studies of existing presence research above showed that the perception, identity and significance of self and objects for research participants, whether in reality or whilst engaged in VR, are continuously variable, relational and malleable. The 'phenomenal field', as developed by Maurice Merleau-Ponty [17] describes how these factors, and the learning process that changes and enriches them, develops within human perception. Within the phenomenal field, a habitual understanding of self and environment is developed in a co-dependent process. Here, the potentialities for motility and interaction with the environment by the body are understood by the body's movement and the responses and sensations felt within the environment. Simultaneously, objects and the environment receive fluctuating significances as they are interacted with, and become more or less relevant according to the particular situation.

Intentionality is at the core of this process. At each interaction, the self maintains a desired intention, modifying the approach and path taken as is needed by the situation. These modifications are, in turn, factored into the event as the body moves through time, closer to its intention; '…previous attitudes and movements provide an ever-ready standard of measurement… At each successive instant of a movement, the preceding instant is not lost sight of. It is, as it were, dovetailed into the present, and present perception generally speaking consists in drawing together, on the basis of one's present perception, the succession of previous positions, which envelop each other' [17]. As well as previous attitudes, the 'impending position is also covered by the present, and through it all those which will occur throughout the movement' [17].

Through this process, a habitual understanding of the potentialities of the self and the environment is developed through intra-action, including actions successfully completed as well as sometimes unexpected, desirable or undesirable consequences. This process can be summarised by what Merleau-Ponty refers to as 'sense-experience' [17]. Here, sensation is not understood outside of the context of experience and there is no fixed notion of self or environment. Nothing can be assigned a fixed identity outside of the fluctuating process itself. Through sense-experience, it is not possible to view objects and experience purely objectively. The self cannot view experience impartially as it is an integral and part of the process, depended and dependent on all factors in its development. Sense-experience describes the process in its 'vital value, grasping it first in its meaning for us, for that heavy mass which is our body, whence it comes about that it always involves a reference to the body' [17].

Sense-experience, as developed by Merleau-Ponty, articulates the non-hierarchical system of exchange that develops meaning and significance for the self and environment from a human perspective. Through intentionality and active experimentation, the self generates an understanding of presence and the role of the environment and the body in its development. As this understanding increases in sophistication, habits are formed and incorporated unconsciously into future interaction with the world; from basic motility, to the use of tools and more practical instrumentalities, and then further into more complex social and cultural interaction. The consolidation of the event understood through intention, the objects featured within it and associated feelings and habits formed are the entities described by Harman through the lens of human perception. It is an investigation into the process of the primary formation of these entities that could serve as a starting point for a post-human research methodology for presence.

C. John Dewey – Experience and Nature

Moving from 'sense-experience', John Dewey's 'Experience and Nature' elaborates on the development of self and boundaries of presence. Dewey departs from the privileging of human perception and the supposed ownership of experience as key components in the formation of self, favouring a position in which all events; whether mental, physical or natural, occur within the same intra-dependent system.

For Dewey, the implication 'that experience by its very nature is owned by someone; and that the ownership is such in kind that everything about experience is affected by a private and exclusive quality' [9] is an absurdity. Rejecting a duality between natural and mental events, Dewey denies that 'traits characteristic of thinking… do not possess the same existential character as do the objects of valid knowledge' [9]. These traits, listed as 'uncertainty, ambiguity, alternatives, inquiring, search, selection, experimental reshaping of external conditions… are evidential of the character of the world within which thinking occurs' [9]. Dewy states that 'the ultimate evidence of genuine hazard, contingency, irregularity and indeterminateness in nature' [9] can be found mirrored in the processes that underlie thought. It is argued here that 'experience when it happens has the same dependence upon objective natural events' [9] as it does other physical, social or mental events. It is 'among and within these occurrences, not outside of them nor underlying them' in which can be found 'those events which are denominated selves' [9].

Dewey also suggests that 'the feature which characterises symbolism… which later reflection calls a symbol is not a symbol, but a direct vehicle, a concrete embodiment, a vital incarnation' [9]. Objects and events presented by reflection are described as 'condensed substitutes of actual meanings and events, which they embody actual things with more direct and enhanced import than do the things themselves with their distractions, imposition and irrelevances' [9]. Dewey later comments that 'underlying 'reality' and surface 'appearance'… have a meaning fixed by the function of inquiry, not an intrinsic metaphysical meaning' [9]. It is necessary to apply the caveat here that these symbols, brought forth by reflective human thought, can only be developed by the function of enquiry based on human understanding. Whilst

an image of thought that occurs amongst and in co-dependence with natural processes is a positive step towards a post-human standpoint on presence, this image of thought itself is context specific nonetheless and cannot be said to bring us closer to 'actual things' or absolutes. The term 'vital incarnation' is apt; suggesting a context specific and unique life of an event developed in conjunction with another vital, living object/event, albeit with the distractions, impositions and irrelevances that accompany it.

Dewey begins to describe the process of development leading to this 'vital incarnation', and its relationship in forming and being formed by other events within perception for humans and other organisms, through the process of habit-forming. Here, Dewey describes how an emergent awareness and understanding of the body and the environment is formed through continued and varying interaction. Relevant memories and previously formed habits are factored into the execution of new interactions and the formation of new habits, whilst new events simultaneously modify previously formed habits and memories. Each new interaction with the environment features 'numerous and complex' conditions for its execution involving 'search and experimentation; the organism is compelled to make variations, and exposed to error and disappointment' [9]. The success of this awareness and learning process requires the organism to have an 'increased susceptibility, sensitiveness, responsiveness' [9]. Highly complex situations, including that of human perception and interaction, will feature many overlapping conditions and opportunities for variation. These events are never fixed or wholly repeatable; they are defined by and contingent on their 'instability, novelty, emergence of the unexpected and unpredictable combinations' [9]. For Dewey, it is this novelty that induces an awareness of the event; a 'shock, and an accompanying perception of dissolving and reforming meaning' [9]. As well as events that are perceived as particularly novel or interesting, the same can be said for each familiar, successive instant as it is perceived; 'The familiar does not consciously appear, save in an unexpected, novel, situation, where the familiar presents itself in a new light and is therefore not wholly familiar' [9]. Each new action requires a new perception, and with it another reforming of meaning.

Presence, the instant of reality, as understood from a human or non-human perspective, or between individual humans and/or non-humans, is 'a moving growing, never finished process' [9]. Perception witnesses each moment of presence solidifying, striking the end of a particular process and instigating a new event, each one dependent on the intentionality of the organism and the past, present and anticipated future for its development. There is 'no single all-at-once beginning of everything' [9] and neither is there a true end to presence. Dewey describes that 'the self is not something ready-made, but something in continuous formation through choice of action' [8]. However, as described by Harman, underneath perception, 'choice of action' or any particular model for reality, there is a groundless, amorphous totality that cannot be punctuated in this way. A review of Merleau-Ponty and Dewey has shown some of the intra-

dependencies that formulate what is offered to reflection by the perceptual faculties of a particular organism. However, this model alone could be said to homogenise experience, discarding much of the richness and disparity that occurs between individual events, regarded as selves or otherwise. A more detailed examination into the possibilities of a ground for thought itself is required.

D. Gilles Deleuze – Difference and Repetition

The philosophy of Gilles Deleuze challenges the homogenisation and supposed universality of representative models of thought. In 'Difference and Repetition' [5], Deleuze articulates a model of the sub-representative sense-making processes that underlie and generate the moment of awareness, or presence, as it is recognised by reflective thought. Deleuze argues that, behind the comprehension of self or object that is delivered up for reflection, there is a pre-individual and chaotic process that brings them into being. Deleuze describes this process as a forced, 'dark precursor' [5] which eventually gives rise to identity or resemblance. Here, 'sensation and that which can only be sensed are one in the same thing' [5]. Each element of sensation and the synthesis of these into a coherent form of representation is a result of a forced communication, 'when each disjointed faculty communicates to another the violence which carries it to its own limit' [5].

It is a groundless 'free form of difference which awakens the faculty, and awakens it as the different within that difference' [5]. Difference is not understood here as dissimilarity between identities of objects already comprehended within representation. Rather, it is a timeless, pure difference that signifies the continual beginning of thought, what Deleuze describes as 'fiery imperatives, these questions which are the beginning of the world' [5]. These 'fiery imperatives' can be likened to Dewey's description of the unexpected, novel 'shock' that catalyses sense-making processes. For Deleuze, the process of becoming that culminates in the moment of presence finds its initiation in the form of a continual problem, or question; the never-ceasing intra-action between objects and the sense-faculties of a particular organism, and the forced and complex communication between these faculties. Deleuze describes that, where 'representation has identity as its element and similarity as its unit of measure, then pure presence such as it appears in the simulacrum has the 'disparate' as its unit of measure – in other words, always a difference of difference as its immediate element' [5].

It is this continual groundless difference that leads Deleuze to discuss repetition, or the continuation of the sense-making process. However, repetition here is not understood as an ending of one sense-making process, thus instigating a new one. Rather, repetition is a 'reprise of pre-individual singularities which, in order that it can be grasped as repetition, presupposes the dissolution of all prior identities' [5]. Difference and repetition simultaneously signify both the beginnings and endings of thought in a process that cannot be adequately punctuated by either; 'everything has its beginning in a question, but one cannot say the question itself begins. Might the question, along with the imperatives which it expresses, have no other origin than repetition' [5]. Deleuze

states that attempting to describe repetition through a material, representative model is 'unthinkable'. Repetition is 'contemplative and contracting, but non-representing and non-represented' [5]. The model of repetition requires the installation of 'sub-representative syntheses… capable of contracting the cases or the elements into one another' [5]. This contraction is not 'external to what it contracts', and the difference in repetition is not 'external to repetition: it is an integral part of it, the constituent part, the depth without which nothing would repeat on the surface' [5]. Difference and repetition, or sub-representative sense-making, is in continuous action; a non-temporal process that cannot be adequately described as a succession of instants, in which sense and thought initiate and depend on each other.

As with Harman, Merleau-Ponty and Dewey, no identity, or a clear distinction, of or between self and environment, or a universal capacity or specific, repeatable process for sense-making pre-exist within this model of thought. Deleuze describes that 'it is the fortuitousness of the contingency of the encounter which guarantees the necessity of that which it forces to be thought. There is no amicability…It is a forced and broken connection which traverses the fragments of a dissolved self as it does the borders of a fractured I' [5]. It can be argued that these 'broken connections' that traverse a 'dissolved self' are related to the 'tangible contours' as discussed by Harman. Objects, sense-making faculties, 'the thousands of passive syntheses of which we are organically composed' [5], and the eventual emergence of self and presence all bring each other into being by their intra-action. No entity, identified as 'self', can be given sovereignty over the co-dependent process and other entities that form it. Presence is not a phenomenon exclusive to human or non-human perceptual faculties. Rather, it is the process that generates the formation of being itself within specific contexts. Objects still intra-act and bring forth each other's being without being scrutinised by sentient entities. The 'totality known as world' [12] still operates, and with it comes an infinity of different contexts for being, each generating its own evolving presence along the way.

IV. POST-HUMAN PRESENCE RESEARCH DESIGN

The philosophical critique of presence above begins to articulate a post-human standpoint on presence. The following section outlines some suggestions for how post-human research design could be approached, addressing the issues highlighted with existing research methods.

A. 'Deterritorialisation' and 'The Plane of Immanence'

Philosophical analyses of presence have indicated an abandonment of representation and reflection in favour of an exploration into the processes that underlie them. Each formation of the instant within representation signifies an individual moment of presence for the perceiving subject. However, Deleuze argues that 'those propositions by themselves give a completely inaccurate notion of the instance which engenders them as cases… By contrast, the idea and 'learning' expresses that extra-propositional or sub-representative problematic instance' [5]. The idea of learning

used to describe the formation of presence is a recurring theme within the philosophical works considered; whether in the form of habit-forming, sense-experience, or the more global evolving emergence of actualisation from a series of possibilities. Post-human experiment design may benefit from adopting elements of these models in its approach.

Instead of using VR within presence research in an attempt to prove the effectiveness or veracity of a pre-existing theory or measure for presence, post-human presence experiment design could instead invite participants to explore the open-ended and evolving experience of presence as it is uniquely formed for them. Participants are encouraged to abandon notions of self and environment as they are habitually understood and invited to reconsider their understanding, discovering how each element is created in intra-action. This process is akin to Deleuze and Guattari's concept of 'deterritorialization'. Here, objects, meanings and understanding itself is continually deterritorialized and reterritorialized, on small and large scales, for physical, social, cultural, philosophic, scientific, historical and a variety of other reasons. 'For the hominid: from its act of birth, it deterritorializes its front paw, wrests it from the earth to turn it into a hand, and reterritorializes it on branches and tools' [6]. Encouraging deterritorialization of the self and environment into unpredictable forms could encourage a wider understanding of the various factors that contribute to the formation of these, helping to establish a post-human understanding of presence.

Further to the above, any representative or habitual understanding of objects and environments held by researchers should, where possible, be eliminated. Nor should VR environments be designed in such a way as to attempt to represent the experience of other beings. As Deleuze states, 'It is not enough to multiply perspectives in order to establish perspectivism. To every perspective or point of view there must correspond an autonomous work with its own self-sufficient sense: what matters is the divergence of series, the decentering of circles' [5]. Post-human presence experimentation must work to deliberately diverge from pre-existing theory, habitual understanding and preconceived notions of self, sense, environment and world as fixed entities. Unpredictability, relinquishing of control and unexpected outcomes are encouraged. The use of VR here provides the opportunity to reframe experience in novel ways, inviting participants to consider their own sense-making capacities as they are put to action, and then to use these insights to consider how these are related to and built from all other factors within the event.

Deleuze and Guattari's concept of the 'plane of immanence' [6] is where divergence and deterritorialization occurs. Deleuze and Guattari describe the plane of immanence as the 'absolute ground of philosophy, its earth or deterritorialization' [6]. It is the image of thought 'that gives itself of what it means to think, to make use of thought, to find one's bearings in thought' [6]. It is not a particular method, 'a state of knowledge on the brain and its functioning [6], a collection of concepts, or holds any specific opinions about thought. The plane of immanence 'retains only what thought

can claim by right… only movement that can be carried into infinity' [6]. This movement 'takes in everything, and there is no place for a subject and an object that can only be concepts' [6]. The plane of immanence is 'the horizon itself that is in movement' [6]. However, as identified by Harman, this horizon is not generated between the thing and its ground, but is rather the groundlessness in which all sub-representative entities, pre-individual singularities and intra-actional events occur. Deleuze and Guattari describe that philosophy is done when 'we head for the horizon, on the plane of immanence, and we return with bloodshot eyes, yet they are the eyes of the mind' [6]. It is here also that post-human presence research should take place.

V. CONCLUSION

A critique of contemporary presence research and a review of relevant philosophical perspectives has shown that the concept of presence is vastly complex. Existing presence research is laden with researcher held pre-suppositions and theories that can skew experiment design and the interpretation of results. The post-human standpoint on presence articulated here addresses these issues, providing the beginnings of a framework to approach the concept of presence from a more balanced and contingent perspective. This will require ongoing and ever-evolving investigation as new contexts and modes of being and experiencing are researched.

The overall standpoint argued here is that presence cannot be universally measured or defined. Presence research design, taking uncritical approaches to world-hood via representative models of reality and perception, excludes much of the richness of experience and the intra-dependence of contributing factors. The endeavour to understand presence as articulated here is motivated by an awareness that a human projection of reality is just one of many. This research aims to develop an enriched understanding of the intra-dependencies that connect collective realities, the deterritorialization of human perception as the sovereign mode of understanding, and an avoidance of the homogenisation of experience into universals, or absolutes. This could aid in developing a further understanding, and modes of communication, for and between beings engaged in a variety of disciplines; including the social, environmental and medical sciences as well as experiential design and contemporary philosophy.

The endeavour to research presence from a post-human standpoint will require collaboration from a variety of different human and non-human perspectives, in a process similar to what Donna Haraway calls 'sympoiesis' or 'making-with'; quoting Dempster as she describes 'collectively producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change' [7, 11]. Haraway explains that 'ontologically heterogeneous partners become who and what they are in relational semiotic-material worlding' [11]. The practice of post-human presence research as articulated here consists of experimentation and a demonstration of the possibilities of worlding in this way.

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