Spatial Presence in Virtual Worlds as a perceptual emotion: An expansion on cognitive feeling?

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Abstract— Understanding learner’s emotions within virtual worlds enables more effective learning solutions to be developed. Spatial presence as a ‘feeling of being there’ has a significant impact upon this effectiveness within immersive learning environments. This paper argues that spatial presence is a perceptual emotion and that such a view can be related to theories of affective emotion as a perception. It argues that existing models of spatial presence as cognitive feeling can be modified and related to perceptual theories of emotion such as Prinz’s embodied appraisal theory and Deonna’s perspectival view of emotion as perception. This supports the approach that spatial presence is better understood as an affective emotion. Applying embodied appraisal theory to the activation of motor areas and aspects of embodied cognition underlying Schubert’s model highlights the perceptual nature of this emotion. Applying situated affordances and action potentials, as expressed in Deonna’s model of emotion, as perception to frames of reference within a virtual world supports arguments for spatial presence as a perceptual emotion similar to Schubert’s use of Wirth et al.’s model of spatial presence. This model may be useful when considering the learner scaffolding of games such as the Alice Civil Emergency game.

Keywords-component; emotion; spatial presence; cognitive feeling, perceptual emotion, embodied cognition, situated cognition, embodied appraisal

I. INTRODUCTION

There is a growing body of evidence to support the view that there is a relationship between spatial presence within virtual worlds (the feeling of being there or “sense of being there” [1:161] and emotion [2–6]. There is further evidence that spatial presence is a factor in effective learning [7–10]. Schubert [1:162] states that “Theories are now being developed that try to explain which cognitive processes are involved in the perception and interaction with virtual environments, and how these processes lead to presence” and continues to state that “Feelings have a perceptual quality to them” [1:164].

This paper argues that spatial presence is a perceptual emotion (emotion as a kind of perception). It does this by considering emotion as a form of embodied appraisal [11] (that the emotion is in itself an appraisal based upon bodily perceptions) and a situated perspectival perceptual emotion[12], [13]. Considering emotion as a perception to include perspectival aspects, as argued by Deonna [12] with his perspectival view of emotion, provides a link to modified models of spatial presence in virtual worlds such as that by Wirth et al. [9].

This paper expands upon and contrasts with Schubert’s cognitive feeling (a feeling with no distinct object e.g. the feeling of knowing) model of spatial presence [1]. This model views the cognitive feeling of spatial presence as signals that are felt because they have no conscious source. He goes on to suggest Wirth et al.’s [9] model of spatial presence within virtual worlds provides a theoretical link with this model; a modification of which is used in this paper.

Schubert defines spatial presence as “The experience of this feeling in virtual environments, mediated real (remote) environments, or real environments is referred to as spatial presence.” [1:163]. This paper will therefore use a similar definition expressed as:

A perceptual emotion consciously experienced as the feeling of being there in virtual environments, mediated real (remote) environments, or real environments is referred to as spatial presence.

II. BACKGROUND

A. Spatial Presence as a cognitive feeling

Schubert [1] argues that spatial presence is a cognitive feeling. His model uses concepts of embodied cognition (meaning and knowledge is embodied as actions or potential actions) [14], [15] and fits with evidence that activation of motor areas within the brain occur prior to actual action [16] to form a generalised model for spatial presence. Parallels between this model and an overview of the characteristics of
affective and cognitive feelings lead him to conclude that spatial presence in general is a cognitive feeling. A key element of his argument is that feelings are signals from an unconscious inferential process to consciousness so enabling conscious decisions to be made. The unconscious inferential process utilises not only cues from the external environment but also propioceptive (sense of the relative position of parts of the body) cues. These signals are felt as they appear to have no source (a cognitive feeling). Schubert [1] goes on to suggest that Wirth et al.’s [9] model of spatial presence (as normally conceived of relating to virtual worlds) provides a theoretical link between his generic understanding of spatial presence as a cognitive feeling and virtual worlds.

B. Affordance

Affordance is a concept of perception relating not to seeing an object as a thing with features, e.g. a stool as a flat wooden piece supported by four wooden uprights, but as an object that is “sittable upon”, i.e. organisms perceive their environment in terms of what that objects affords them. The term is derived from the work of Gibson [17] who argued that as organisms, perception and the environment has evolved together that there was a direct linkage between the perceived object and the affordance offered. No intervening cognition is needed. It is closely related to seeing the world in terms of actual or potential actions. Actions are termed lawful to the extent that they fit with this natural relationship.

C. Memory in embodied cognition.

Schubert [1] draws upon Glenberg’s [14] approach to embodied cognition that focuses upon meaning or knowledge as actions embodied within memory. These embodied representations have a structure that is lawfully related to objects being represented [14]. Conceptualisation is seen as encoding “patterns of possible physical interaction with the world” [14:1]. The relationships between concepts or such potential actions are encoded by combining them together as a “mesh”. Incorporating new potential actions transformed a mesh into a new mesh. Normally these derive from the surrounding natural environment and are “locked down” to avoid hallucination. Conscious and deliberately thought concepts require a suppression of such automatic external input to this mesh in order to change a mesh into a new one with the deliberate concepts involving imagined or predicted action possibilities. This suppression of the external environment inputs to overcome the “locked down” mesh is effortful. This effort is the “feeling” of memory.

D. Emotion as perception and embodied appraisal

Embodied appraisal theory as proposed by Prinz [11] is a neo-Jamian theory (that argues emotions derive from bodily behaviour ‘I tremble therefore I fear’) and links both high level ‘cognitive’ emotion and low level basic emotions (e.g. guilt and fear respectively) into one general model of emotion. Prinz [11] argues that emotion involves the perception of bodily effects. This perception represents core relational themes (the general gist of an emotion such as guilt or fear) as suggested by Lazarus [18], [19]. Prinz’s model distinguishes the emotion from the elicitors of emotion e.g. judgments (conscious or unconscious), other perceptions and ultimately the external environment. In this theory basic emotions are calibrated by judgments to provide high-level emotion based upon representations that can trigger the same or similar patterns of bodily response to a basic emotion. E.g. a calibration ‘file’ for jealousy contains representations to track infidelity. This could calibrate an emotion such as anger.

E. Emotion as a perception is ‘seen’ from a perspective.

Perceptual views of emotion [11–13] often draw upon parallels between emotion and perception. Deonna [12] draws upon models of perception having a perspectival and factual aspect [20], as do emotions, as perspectival perception so drawing on concepts of affordance [17] e.g. an apple is ‘throwable’ only if we have an arm and hand size suitable to hold and throw the apple. Emotions track how things are, evaluatively, with respect to ones perspective on it [12]. Deona suggests that we have a ‘frame of reference’ as a ‘table’ registering the different ways that information can be couched (as potential actions or readiness for action) [12], [21]. He then goes on to relate this to our “evaluative tendencies and character traits”[12:37].

F. A Model of Spatial Presence (in virtual worlds).

Schubert [1] draws upon a theory of spatial presence in virtual worlds developed by Wirth et al. [9]. This theory argues that people created situated mental models (SMM) in their minds. This is developed from various cues around them. They utilise a theory of perception that the various cues are brought together and tested against a plausible hypothesis[22]. Normally the sense of where we are located around where we are in the ‘real’ world i.e. our ego reference frame (ERF) is located in the ‘real’ world. The theory argues that people always have a primary ERF (PERF), usually located in the real world. Cues from within a virtual world may be such that the hypothesis accepted is that our perceived ERF is situated within the virtual world. In this case our PERF is no longer located in the ‘real’ world but the ‘virtual’ world instead [6], [23], [24]. When this occurs people feel present in the ‘virtual’ world. Schubert argues that Wirth et al.’s [9] model is supportive of his use of embodied cognition so completing his argument.
III. DISCUSSION

This part discusses the case for spatial presence as a perceptual emotion. It breaks the arguments into four parts: Spatial Presence as Embodied Appraisal; Feeling and Emotion, Spatial Presence as Perspectival Perceptual Emotion; Spatial Presence within virtual worlds.

A. Spatial Presence as an Embodied Perceptual Emotion

Schubert’s cognitive feeling view of spatial presence [1] builds upon concepts of embodied cognition involving embodied meaning encoded as bodily patterns of possible actions and the suppression of incompatible sensory input in memory [14], [15]. This is closely related to research indicating that motor areas of the brain are activated prior to any action [25]; the embodied meaning within these motor areas provide a sense of spatial presence with feelings being a signal communicating from the conscious to the unconscious. This then enables conscious decisions about possible actions to be taken.

Schubert [1] draws parallels between characteristics of feeling and spatial presence in support of his argument that spatial presence is a kind of cognitive feeling namely: feelings are caused by unconscious processes; feelings are immediate; feelings are always true; feelings get attributed; feelings have informative value; feelings vary in intensity and feelings (often) have valence. Embodied appraisal theory [11] considers emotion to be an embodied appraisal and to be a kind of perception. It holds that they represent core relational themes (e.g. danger) as a perception of embodied bodily changes.

1) Appraisals

An appraisal is a representation of the relation between an organism and its environment. Emotions are embodied appraisals [11] not the result of disembodied conscious cognitive appraisals [18]. The inferential heuristics of Schubert form non-conscious appraisal drawing upon spatial and propriational cues. These inferential heuristics are assessing the relation between an organism and its spatial place within the environment. An embodied appraisal is a state that relates an organism-environment relation that bears upon well being. Schubert [1] similarly argues that spatial presence [a state] is an organism-environment relation that bears upon well being. Spatial presence as an embodied appraisal emotion is therefore consistent with the inferential heuristics associated with spatial presence as a cognitive feeling.

2) Core Relational Themes

A core relational theme is the gist of the emotions. For Lazarus’ [18], [19], who originated the concept these are disembodied cognitive appraisals (forming judgements). These are tracked and represented by embodied appraisals (as emotions) [11] in a manner similar to the heuristics of Schubert’s [1] track and represent spatial presence. The themes capture the fuzzy edged aspect of feeling and emotion. It relates to the sense of emotions having a certain ambiguity about them.

Prinz [11:68] views a core relational theme is “a relation that pertains to well being”. Schubert [1] views the valent aspect of spatial presence as “Feeling not present (anywhere) amounts to feeling disoriented and a negative state.” [1:175]. This paper agrees and suggests that the core relational theme here is “disorientation” which does pertain to well being. As embodied appraisals are consistent with Schubert’s [1] inferential heuristics so core relational themes are consistent with the feeling aspects of Schubert’s spatial presence.

B. Feelings and Emotions

Schubert’s model is focused upon feelings. Embodied appraisal models such as Prinz’s [11] on emotion.

1) Generation of Feeling.

Spatial presence as a perceptual emotion needs to account for the generation of feeling itself. Schubert argues that this feeling “provides feedback from the unconscious cognitive processes that informs conscious thought about the state of the spatial cognitive system” [1:161].

For Schubert the unconscious heuristic is the elicitor of feeling as a signal to the conscious without needing conscious conceptual thought. This generation of feeling is based upon ideas by Glenberg [14:11] who states that “the feeling of memory comes from the effort [This paper’s italics] of suppressing the environment and the consequent knowledge that conceptualisation is being driven by previously created trajectories” (Changes to the enmeshed patterns within memory).

As this feeling is a consequence of applying conscious thought it would occur after such a thought. It is therefore too late to act as the signal from the unconscious to conscious for conscious actions to then be taken. If, as in the embodied appraisal approach, feeling is the conscious manifestation of emotion then emotion could act as such a signal and is consistent with emotion tracking the core relational themes.

2) The Consciousness Issue

Prinz [11] proposes a hierarchical model of perceptual emotion with three levels: low level, intermediate and high level emotion suggests that only intermediate and high level aspects of this hierarchy are available for conscious thought (see figure 2 below where the aspects accessible to consciousness are in grey). One of the arguments for the perceptual approach to emotion is not only that it accounts for non-cognitive thought but also that the hierarchical nature of emotion aligns with perceptual structures and pathways similar to regular perception.
In embodied appraisal theory it is this conscious experience of emotion that is feeling. Schubert [1] is focused only upon feeling, so the focus is placed fully on the phenomenal experiences but when considered as an emotion, unconscious and unfelt aspects mean spatial presence can be both unconscious and conscious.

3) Spatial Presence in the affective domain

This paper asserts that the cognitive-feeling of spatial presence is an affective emotion. Schubert [1] accepts that spatial presence as a cognitive feeling can be affective and have valence as discussed in the section under core relational themes above. He argues that affective feeling can result from the perception and subsequent evaluation of external events or objects. [1:167]. Appraisals do just that.

Schubert [1:168] considers mood a cognitive feeling “It is not necessary to judge on the basis of other information what mood you are in, or in other words, to consciously infer it from something else.“ However mood is catered for within the embodied appraisal theory where moods are considered emotions “classical emotions and moods differ only in their intentional contents” [11:188]. Schubert states that some factor analyses of fear and happiness did not load well onto spatial presence [15], [26] suggesting spatial presence is unrelated to affective emotion. Whilst other research does e.g. fear and anxiety[27], [28] such affective emotions have different core relational themes and are not the same emotion as spatial presence itself.

C. Spatial Presence as Perspectival Perceptual Emotion

This section explores the perceptual aspects of emotion [1], [11], [12] and the importance of emotion being seen from the organism experiencing the emotion. It argues that perceptual emotion and cognitive-feeling spatial presence (utilising embodied cognition) are situated and utilise the concepts of affordance. Secondly this section relates a modified embodied appraisal model of emotion to the perspectival aspect of emotion. Finally it applies the concept of frames of reference of the perspectival approach of emotion to spatial presence.

1) Situated Affordances


2) Perspectival Perception and Embodied Appraisal

The model of embodied appraisal discussed as expounded by Prinz [11] focuses upon perceptual emotion focused internal onto the bodily responses. Perspectival model of emotion are focused upon the external environment. One criticism of the embodied appraisal model is that using judgement as an elicitor of emotion is a form of cognitive appraisal [29]. Whilst disagreeing that this is the disembodied cognitive appraisal used in cognitive appraisal theory a non-cognitive explanation does need to be sought.

This paper proposes that a better approach would be to recognise that such judgements are themselves Gibsonian perceptions [17] perceiving the external emotional environment as affordances. These embodied judgements lead to the triggering of bodily mechanisms perceived by embodied appraisals. In effect there is a confluence of perception that forms both judgements and appraisals. This then associates the internal and external perceptions. However unlike Lazarus [18], [19] who considered these judgements to be core representational themes this paper also maintains the perceptual embodied appraisals still represent these core representation themes.

This approach accounts for perspectival aspect of emotion as perception, the embodied aspect and the role of bodily functions.

3) Frames of Reference.

This paper agrees with Deonna [12] who discusses two aspects to perception as proposed by Noê [20]: a factual dimension (how things are) and a perspectival dimension (how things appear from ones perspective). The perspectival approach includes the concept of affordances drawn from the Gibsonian model of direct perception [17] although Deonna is not committed to the direct aspect.

A key concept is that there is a frame of reference of this perceptual system. This frame of reference contains the full range of possibilities for that individual and species e.g. an apples graspability may depend upon the length of your arm. Considering emotion as perspectival perception Deonna [12] suggests that if true the contrast between emotion and
perception ceases to be important. Deonna proposes that the emotional experience of object o is a case of representing object o as calling for a certain behaviour.

Deonna links this frame of reference to emotional dispositions, which may, but not exclusively, relate to character or personality traits and prior experience. These frames of reference are physically as ‘tables’. In a similar fashion embodied appraisal theory has ‘mental files’ and ‘calibration files’ (used to modify more basic emotions). Glenberg’s [14] embodied cognition underlying Schubert’s model also [1] embodies such patterns of action in a ‘mesh’. This paper argues therefore that spatial presence draws upon understanding the environment in terms of affordances in a similar manner and hence has the capability to perceive the surrounding environment.

D. Spatial Presence within virtual worlds

In a similar approach to Schubert [1] this paper has developed a generic model of spatial presence outside of virtual worlds but as a perceptual emotion. Spatial presence as a cognitive-feeling builds upon theories of embodied cognition and utilises Wirth et al’s [9] model of spatial presence within virtual worlds to provide a possible theoretical link to spatial presence to the virtual world (as the term normally refers too). This model utilises the concept constructed a spatial mental model (SMM) to produce a primary ego reference frame (PERF). The theory argues that people always have a primary ERF (PERF), usually located in the real world. It is possible for cues within a virtual world to be such that the hypothesis during perception that is found acceptable our perceived ERF is situated within the virtual world. In this case our PERF is no longer located in the ‘real’ world but the ‘virtual’ world instead [6], [23], [24].

The use of the ego reference frame (ERF) has parallels with the usage of a framework of reference for emotional perception[12] when discussing the perspectival nature of spatial presence as a perceptual emotion. This utilises the concept of affordance and does not rely upon an intervening perceptual hypothesis theory [6], [9] as it is itself an perception. This paper argues that the affordances relevant to the spatial presence emotion are drawn from the computer generated virtual world then the loci of this framework of reference will change. A framework of reference co-located with an avatar would relate to the to the affordance to the avatar. The affordance relevant to the spatial and orientation aspects of the avatar would replace spatial cues.

As an emotion this spatial presence can be consciously felt which accounts the “feeling of being there” and the ability for participants can rate subjective presence measures as intensity using likart scales. [26], [27], [30].

IV. CONCLUSIONS

Spatial presence can be a perceptual emotion. This perceptual emotion model of spatial presence tracks a core relational theme “disorientated”.

The affordance relevant to the spatial and orientation aspects of spatial presence would replace spatial cues for perceptual hypotheses in Wirth et al’s [9] model of spatial presence within virtual worlds and form a framework of reference co-located with an avatar that relates to the to the affordance to the avatar. Perception of both the bodily responses and the external environment work together as a confluence of perceptions.

It meets all of Schubert’s [1] criteria of feelings (as a conscious manifestation of emotion) in that they are caused by unconscious processes; feelings are immediate; feelings are always true; feelings get attributed; feelings have informative value; feelings vary in intensity and feelings (often) have valence.

Spatial presence as an emotion accounts for both subjective [6], [23], [27], [31–33] and nonconscious behavioural definitions [34–36] of presence e.g. A fire fighter unknowingly acted anxiously near a virtual pit [6:437]. The Gibsonian/Heideggerian [17], [34], [37] nature also allows for concepts of flow [38][39] and associated with concepts of associated psychological models of immersion. [40], [41]

Further research applying spatial presence as a perceptual emotion to enactive approaches to presence and learning within games such as the ALICE Civil Emergency game [42] may prove useful.

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