‘It’s been Emotional’: Affect, Physiology, and Presence.

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1. Summary:

Emotions are key factors to consider when examining people’s experience of and interactions with mediated environments. This paper explores the concept of presence in relation to enhanced television and film presentations, which are often designed to produce emotional reactions. It is proposed that in emotive mediated environments, autonomic indicators of emotional intensity may have some utility as indicators of presence. Previous research in this field is presented along with a recent study designed to investigate how content and display variations affect the relationship between presence, emotion and autonomic arousal.

2. Introduction

2.1 Presence, Television and Film

The marketing of television and cinema illustrates that an enduring promise of entertainment system developers has been to deliver realistic and intense mediated experiences, designed to immerse us in alternative worlds and enhance our connection with the characters in them. For example, one advertisement from the 1950’s depicts Alice in Wonderland seated before a television receiver. The text suggests that Alice will see more of the world than a ‘member of an elder generation could have seen in a busy lifetime’ and that she ‘will see it as clearly as if she were there’ on the ‘big, clear, direct view screen’.

The implication that the extent and fidelity of sensory information provided to a viewer will lead to an illusion of reality is one that is explicit in the presence research literature (e.g. Sheridan, 1992; Slater & Wilbur, 1997). Presence is usually used to refer to the ‘(psychological) sense of being there in a virtual environment’ (Slater & Wilbur, 1997). However, many researchers have applied the concept of presence to television and film viewing (e.g. Freeman & Avons, 2000; Kim & Biocca, 1997; Lombard & Ditton, 1997). Aspects of media form and media content are thought to contribute to feelings of presence in virtual environments and are also relevant to discussions of other media. Display properties (e.g., the realism of the visual image) and features of content (e.g., ‘plot’) may both contribute to feelings of presence in televised environments.

Although the concept of presence has been applied to conventional television and film viewing, features of this type of mediated experience may not lend themselves well to the elicitation of presence. Lombard and Ditton (1997) argue that televisual and cinematic conventions such as flashbacks, the passage of time, the use of music and the appearance of credits may alert viewers to the mediated nature of their experience, and so reduce presence. Furthermore, though television and film images are photo-realistic, the visual and auditory information provided to viewers is relatively poor in comparison to the multi-sensory experience of everyday life. This may allow some psychological distance from depicted events, permitting viewers to have intense feelings without actual involvement (Stephenson and Phelps, 1989). In addition, sensory information from the real world, such as the feeling of a seat beneath you, may compete with sensory information from a screen, serving to reduce presence (Barfield, Zeltzer, Sheridan & Slater, 1995).

However, recent advancements in entertainment system technologies may mean that presence is an increasingly relevant concept in terms of cinema and home viewing (Reeves, Detenber & Steuer, 1993). The introduction of digital television into our homes combined with the current convergence of media and communication technologies may afford the possibility of more frequent, interactive mediated experiences with a high degree of sensory richness, (e.g., through the use of wide-screen and surround-sound technologies). These enhancements of conventional presentations could potentially lead to more frequent experiences of presence in the cinema and at home.

2.2 Presence and Emotion:

Entertainment system developers also promise that display enhancements, such as those that could lead to experiences of presence, will also lead to greater emotional intensity. For example, a horror film may be more terrifying when seen on a large screen and a roller-coaster ride more exhilarating when seen in 3D. Investigations of the relationship between presence and emotion may have some utility in furthering the understanding of the structure, determinants, consequences and measurement of presence.

Levenson (1994) has described emotions as “short-lived psychological-physiological phenomena that represent efficient modes of adaptation to changing environmental demands”. Others have also proposed that emotions serve functions (i.e., guiding goal-directed behaviour), can be viewed as having several components (e.g. experiential, physiological and behavioural) and have beneficial consequences (i.e., survival) – (for a review, see Keltner & Gross, 1999). Emotions are therefore an important factor to consider when examining a person’s experience of, and interaction with, an environment.

Subjective emotional experience can be described as having both a quality and an intensity. Mandler (1992) suggests that the quality of an emotional experience is determined by the ‘cognition of values’

(e.g., whether a stimulus is evaluated as positive or negative). The intensity of an emotional experience, Mandler claims, is provided by the strength of visceral arousal, (i.e., activation of components of the autonomic nervous system, such as heart-responses and sweat gland activity). These 'heartfelt' and 'gut' reactions, add 'feeling' to the evaluative cognitions. Intensity may also be determined by the degree to which an event is appraised as relevant to an individuals current concerns (i.e., motives and goals) and the way in which that individual regulates his or her reactions (Sonnemans & Frijda, 1995). Emotional experience may therefore be characterised as requiring some processing and evaluation of the meaning of individually relevant stimuli combined with feedback from physiological systems.

Huang and Alessi (1999) believe that emotional experience is important to the concept of presence, given that emotions play an important role in guiding behaviour. Many parallels can be drawn between the study of presence and the study of emotion, such as multi-level approaches to inferring the quality and intensity of an experience. This is not to imply that presence and emotion are exchangeable constructs. As Barfield et al. (1995) point out, the emotional reactions of movie-goers may be more related to involvement with a story and identification with characters, than sensations of 'being there'. It may however be the case that in some contexts a person's emotional experience does relate to the experience of presence.

Heeter (1992) asserts that personal presence is determined by evidence that suggests to observers their own existence within a mediated environment. It may be proposed that components of an emotional reaction (such as autonomic feedback) may be used as evidence to a participant of their presence in an environment. Alternatively, emotional reactions may occur as a consequence of presence. Such reactions may also be expected to occur in response to features of a mediated environment that detract from presence. Research may be expected to show some relationship between emotional responses and factors that determine presence.

In fact, Meehan, Insko, Whitton and Brooks (2002) have shown that autonomic responses, self-reported fear and self-reported presence correlate when participants confront a virtual cliff through a head-mounted display across a range of viewing conditions. In addition, display manipulations which should enhance presence, such as increasing screen size and adding motion to images, produce more intense patterns of autonomic arousal, elicit more intense reports of subjective arousal and accentuate some differences between contents (Detenber, Simons & Bennet, 1998; Simons, Detenber, Roedema & Reiss, 1999; Reeves, Lang, Kim & Tatar, 1999; Lombard, Reich, Grabe, Bracken & Ditton, 2000). Simons et al., (1999) argue that such display manipulations affect the arousal (intensity) dimension of emotion, and not the valence (quality) dimension.

2.3 Autonomic Indicators of Presence

The findings above suggest that measures of autonomic arousal, such as Heart Rate (HR) and Skin Conductance (SC) could be particularly advantageous as indicators of presence in emotive mediated environments. Autonomic measures are not dependent on conscious deliberation or overt responses, and so may be considered viable, continuous and objective methods of assessing mediated experiences. Various researchers have proposed such measures as indicators of presence (Barfield & Weghorst, 1993; Held & Durlach, 1992; IJsselsteijn, de Ridder, Freeman & Avons, 2000). The unifying idea behind these approaches is that compared to conventional mediated experiences, highly immersive experiences are expected to produce more intense autonomic reactions.

Previous experiments conducted by the present authors (e.g. Dillon, Keogh & Freeman, submitted) suggest the need to examine the content-specificity of autonomic indicators of presence. In particular it is unclear how presence enhancing display properties will affect the quality and intensity of emotional experience across a range of viewing contexts.

In these experiments two of the theoretical determinants of presence (display type and video content) were manipulated in order to determine their effects on several measures. Post-viewing subjective ratings of presence were compared to changes in SC and HR, and self-reported emotion and mood. It was expected that differences between contents, in terms of the quality and intensity of emotional experience, observed for conventional displays would be exaggerated when using high presence displays.

The autonomic measures generally distinguished between two opposing contents (a fast-paced rally driving sequence and a slow-paced boat-ride sequence). However, display types that were associated with relatively high levels of presence (stereoscopic presentations and large visual angles) were not associated with more intense autonomic reactions. Rather, the physiological measures identified effects that were not apparent from the self-report data, such as the impact of the use of a screen-surround designed to enhance depth in monoscopic images.

Our results highlighted the utility of using objective physiological measures in conjunction with self-report measures of presence, particularly when assessing the impact of novel combinations of displays and contents. However, it was surprising that display types that provided a greater extent and fidelity of sensory information were not more physiologically arousing than conventional displays. In addition, while some effects of content and display type on self-reported mood and emotion were observed, these effects were small, diverse and appeared not to be uniformly related to presence.

A ratings study that we conducted, based on Gross and Levenson's (1995) method of film analysis, revealed that in comparison to a wider range of contents, the boat and rally video sequences can described

as having a neutral emotional quality. As such, any content-specific effects of display enhancements on emotional quality and intensity may not have been expected (given that neutral stimuli may not be perceived as more 'important' or 'meaningful' in a high presence environment). The present study aims to address this concern.

3. Experimental Investigation of Presence and Emotion:

3.1 Aims

Based on our previous ratings study, three sets of stimuli were developed for further research. One set contains four video clips rated as emotionally neutral. The remaining two sets contain emotive clips. One of these sets contains four clips that were shown to elicit 'amusement' over and above any other emotion. The second set contains four clips that were shown to elicit 'sadness' over and above any other emotion. This study aims to investigate how a presence enhancing display property (increased visual angle) will affect viewers experience of these three categories of films.

It is proposed that, (1) in comparison to a small visual angle a large visual angle will generate higher ratings of presence; (2) neutral, amusing and sad stimuli are expected to differ in terms of autonomic arousal, emotional intensity and emotional quality; (3) increased visual angle, and so increased presence, is expected to affect ratings of emotional quality, emotional intensity and autonomic arousal; (4) differences between contents are expected to be enhanced for the large visual angle display.

3.2 Procedure:

Two factors were studied in this experiment. 'Content', referring to three categories of video-clips, was a within-groups factor with three levels (*Amusement* vs. *Sadness* vs. *Neutral*). 'Angle', referring to horizontal visual angle, was a within-groups factor with two levels (21-deg. vs. 42-deg.).

Twelve male and twelve female students from Goldsmiths College, University Of London participated in the experiment. The experiment was conducted over two sessions, exactly one week apart. In one session participants viewed the twelve video-clips at a 21-deg. horizontal visual angle, in the other session participants viewed the video-clips at a 42-deg. visual angle. The clips were presented in a pseudo-random order so that no two clips from the same category appeared next to each other, and no participant viewed two clips in the same order at both presentations. The order of presentation sessions (21-deg./42-deg. vs. 42-deg./21-deg.) was counterbalanced across participants.

After each video-clip, participants were required to complete four short ratings scales: Slater, Usoh and Steed's (1994) 3 presence questions; an adaptation of Gross and Levensons's (1995) emotions ratings scale including questions relating to emotional quality (amusement and sadness) and emotional intensity (arousal and interest); questions relating to 'Engagement' and 'Negative Effects' taken from the ITC-

Sense of Presence Inventory (Lessiter, Freeman, Keogh & Davidoff, 2001), and questions relating to image quality. HR and SC recordings were taken during each clip and for 100secs before and after each clip.

Each dependent variable was averaged across the four films in each category. Several dependent variables were extracted from the HR and SC data. The last 60-secs of the pre-film period was used as the initial baseline period. Individuals mean HR and Skin Conductance Level (SCL) values for the baseline period were then subtracted from the mean HR and SCL values for each entire clip, from the 1st, 2nd and last sixty-seconds of each clip, and from the maximum positive and negative deviations during the first two minutes of each film period. The mean HR and SCLs uring the last sixty seconds of each clip was used as a second baseline period and subtracted from the mean HR and SCLs of the sixty-seconds following video off-set (recovery period).

3.3 Results:

A series of 3 x 2 within-groups Analyses of Variance (ANOVAs), with Content (*Amusement* vs. *Sadness* vs. *Neutral*) and Angle (21-deg. vs. 42-deg.) serving as within-groups variables, were used to analyse the questionnaire and autonomic data. Significance levels were set at $p < .05$ (two-tailed). A Greenhouse-Geisser correction was used when the assumption of sphericity was violated. Bonferroni corrections were used for follow-up analyses of significant effects. All significant effects are summarised below (see tables 1 and 2 for means of results relating to predictions).

Table 1: Effects of Content and Angle on Self-Report Measures

		Neutral		Amusement		Sadness	
		21º	42º	21º	42º	21º	42º
Slater et al.'s 3 Questions							
Quest. 1	*Mean*	**2.85**	**3.26**	**3.07**	**3.24**	**3.21**	**3.43**
	SD	*(0.93)*	*(1.22)*	*(1.23)*	*(1.28)*	*(1.04)*	*(1.41)*
Quest. 2	*Mean*	**2.33**	**2.75**	**2.97**	**3.19**	**2.93**	**3.38**
	SD	*(1.15)*	*(1.38)*	*(1.40)*	*(1.32)*	*(1.24)*	*(1.47)*
Quest. 3	*Mean*	**2.75**	**2.95**	**2.51**	**2.44**	**2.51**	**2.88**
	SD	*(1.15)*	*(1.25)*	*(1.23)*	*(1.03)*	*(1.15)*	*(1.25)*
Total Presence	*Mean*	**2.65**	**2.99**	**2.85**	**2.95**	**2.88**	**3.23**
	SD	*(1.00)*	*(1.25)*	*(1.19)*	*(1.07)*	*(1.02)*	*(1.23)*
Hi-Scores	*Mean*	**0.27**	**0.32**	**0.20**	**0.17**	**0.13**	**0.27**
	SD	*(0.55)*	*(0.62)*	*(0.35)*	*(0.32)*	*(0.32)*	*(0.49)*
Key Emotion Terms							
Amusement	*Mean*	**0.72**	**0.79**	**4.04**	**4.07**	**0.73**	**0.84**
	SD	*(0.84)*	*(0.91)*	*(1.94)*	*(1.72)*	*(0.73)*	*(1.00)*
Sadness	*Mean*	**0.35**	**0.44**	**0.21**	**0.28**	**3.65**	**4.06**
	SD	*(0.65)*	*(0.70)*	*(0.34)*	*(0.46)*	*(1.60)*	*(1.75)*
Arousal	*Mean*	**0.89**	**1.25**	**2.34**	**2.91**	**1.96**	**2.63**
	SD	*(0.90)*	*(1.36)*	*(1.92)*	*(2.05)*	*(1.82)*	*(2.09)*
Interest	*Mean*	**1.17**	**1.45**	**3.75**	**3.82**	**2.81**	**3.17**
	SD	*(1.18)*	*(1.08)*	*(1.89)*	*(1.63)*	*(1.61)*	*(1.56)*

Table 2: Effects of Content and Angle on Autonomic Measures

		Neutral		Amusement		Sadness	
		21º	42º	21º	42º	21º	42º
Skin Conductance Levels (standardised): Change from Baseline							
Whole Clip	*Mean*	**-1.06**	**-1.25**	**-0.47**	**-0.60**	**-0.86**	**-0.98**
	SD	*(0.63)*	*(0.53)*	*(0.89)*	*(1.06)*	*(0.78)*	*(0.77)*
1st 60-Secs	*Mean*	**-0.67**	**-0.78**	**-0.37**	**-0.38**	**-0.58**	**-0.61**
	SD	*(0.50)*	*(0.51)*	*(0.72)*	*(0.80)*	*(0.72)*	*(0.65)*
2nd 60-Secs	*Mean*	**-1.06**	**-1.38**	**-0.49**	**-0.62**	**-0.88**	**-1.08**
	SD	*(0.74)*	*(0.57)*	*(1.01)*	*(1.21)*	*(0.83)*	*(0.81)*
Last 60-Secs	*Mean*	**-1.44**	**-1.49**	**-0.55**	**-0.72**	**-1.13**	**-1.22**
	SD	*(0.79)*	*(0.74)*	*(1.09)*	*(1.28)*	*(0.88)*	*(1.06)*
Recovery	*Mean*	**0.24**	**0.22**	**0.32**	**0.17**	**0.34**	**0.23**
	SD	*(0.58)*	*(0.48)*	*(0.70)*	*(0.54)*	*(0.70)*	*(0.60)*
Min	*Mean*	**-1.87**	**-2.10**	**-1.50**	**-1.62**	**-1.74**	**-1.78**
	SD	*(0.42)*	*(0.64)*	*(0.55)*	*(0.64)*	*(0.48)*	*(0.49)*
Max	*Mean*	**0.55**	**0.42**	**0.95**	**0.87**	**0.61**	**0.43**
	SD	*(0.99)*	*(1.01)*	*(1.10)*	*(1.25)*	*(1.00)*	*(0.87)*
Heart Rate (bpm): Change from Baseline							
Whole Clip	***Mean***	**-1.36**	**-1.09**	**-3.23**	**-3.62**	**-3.65**	**-3.46**
	SD	*(1.45)*	*(1.88)*	*(2.72)*	*(2.59)*	*(2.49)*	*(2.21)*
1st 60-Secs	***Mean***	**-1.66**	**-1.81**	**-3.29**	**-3.27**	**-3.51**	**-3.34**
	SD	*(1.56)*	*(2.41)*	*(2.67)*	*(2.24)*	*(2.56)*	*(1.83)*
2nd 60-Secs	***Mean***	**-1.27**	**-1.18**	**-3.42**	**-4.09**	**-3.98**	**-4.10**
	SD	*(1.63)*	*(1.99)*	*(3.03)*	*(2.73)*	*(2.56)*	*(2.23)*
Last 60-Secs	***Mean***	**-1.26**	**-0.51**	**-3.26**	**-3.64**	**-3.66**	**-3.41**
	SD	*(1.89)*	*(1.90)*	*(3.19)*	*(3.27)*	*(2.75)*	*(3.19)*
Recovery	***Mean***	**0.92**	**1.11**	**3.16**	**2.80**	**4.24**	**3.58**
	SD	*(1.34)*	*(2.14)*	*(2.83)*	*(2.68)*	*(2.08)*	*(3.79)*
Min	***Mean***	**-12.32**	**-11.36**	**-13.67**	**-12.86**	**-14.15**	**-12.81**
	SD	*(3.97)*	*(4.21)*	*(5.55)*	*(5.03)*	*(5.56)*	*(4.21)*
Max	***Mean***	**12.70**	**12.15**	**10.12**	**9.69**	**10.27**	**9.12**
	SD	*(3.81)*	*(4.49)*	*(3.52)*	*(3.29)*	*(4.39)*	*(3.86)*

Content: As expected the *Amusement* category was rated higher in 'amusement' than the *Neutral* and *Sadness* categories, whereas the *Sadness* category was rated higher in 'sadness' than the *Neutral* and *Amusement* categories. The *Sadness* and *Amusement* categories were rated higher in arousal, interest, engagement, image quality and image adequacy, and rated lower in negative effects than the *Neutral* category. In addition, the *Sadness* category was rated higher on Slater et al.'s Question 2 ('There were times when the displayed environment became more real or present for me in comparison to the real world') than the *Neutral* category.

SCLs were generally higher in the *Amusement* category in comparison to the *Neutral* and *Sadness* categories. This was with the exception of the maximum negative deviation from baseline, in which case both the *Amusement* and *Sadness* categories were higher than the *Neutral* category. In addition, no significant effects were observed for the recovery period and the maximum positive deviation from baseline.

HR was reduced to a greater extent for the *Amusement* and *Sadness* categories in comparison to the *Neutral* categories during the whole clip and the 1st, 2nd and last sixty-second periods. During the recovery period HR rose to a greater extent for the *Amusement* and *Sadness* categories in comparison to

the *Neutral* category and HR rose to a greater extent for the *Sadness* category in comparison to the *Amusement* category. The maximum and minimum HR deviations from baseline were greater for the *Neutral* category in comparison to the *Sadness* and *Amusement* categories suggesting a similar range of HR reactivity for the three categories but a greater reduction in HR during viewing for the Emotive categories.

Angle: The 42º angle was rated higher on Slater et al.'s Question 2, rated higher in 'sadness' and associated with a lower negative SCL deviation from baseline than the 21º angle. Effects of Angle on arousal approached significance ($p = .06$) with the 42º angle receiving higher ratings of arousal than the 21º angle.

Content x Angle: Contrary to predictions, no significant Content x Angle interactions were observed.

4. Discussion:

Contrary to previous research in this project there was no clear overall effect of Angle on presence ratings, limiting the interpretation of the results. Though Contents were well differentiated from each other in terms of emotional quality, emotional intensity and autonomic arousal, increased visual angle did not accentuate these differences. This may be expected given the overall null results for self-reported presence. However, there was some suggestion that Angle affected emotional quality and intensity ratings, one measure of SC and one indicator of subjective presence. These results may suggest a content-general effect of increased-visual angle (as a presence enhancing display property) on emotional responses. This would be in line with Simons et al.'s (1999) suggestion that media form variables affect only the arousal component of emotion.

However, several factors preclude firm conclusions at this stage of the research. In particular, the fact that there was no clear overall effect of Angle on presence ratings was surprising, given that this had been shown to be highly significant in previous research in this project. This discrepancy may be a result of the different presentation methods employed in each study. In contrast to the previous research, in the present study participants did not make direct comparisons between 21º and 42º presentations in the same sitting. Future research must consider whether direct comparisons are a necessary component of presence evaluation. In addition, research must examine whether the results of the present study can be accounted for by task demands, confounding variables, low participant numbers or some actual advantage of large visual angle presentations.

This research further highlights difficulties with self-report measures of user-experience and the need for multi-level approaches to evaluation, such as the use of physiological measures. The findings also

indicate that further investigations of the relationship between presence and emotion are needed. This may be of use for applications specifically designed to target specific components of affective states.

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