Listening, Corporeality and Presence

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Abstract

The use of sound to create or enhance the sense of presence is well recognized and the measurements of which have focused on hearing, e.g. "were you able to identify a particular sound?", "how well could you localize the sounds". To this treatment of audition we now add, listening. Listening is active, directed, intentional hearing. This aspect of the phenomenology of sound - listening - has received relatively little attention from the presence community. Focusing on listening has one further consequence - it underlines the corporeality of the listener. Listening is not merely ego-centric it is body-centric. Hearing, in contrast, is allo-centric – "The sounds appears to be coming from over there". We suggest that an exploration of the nature of listening in virtual environments may contribute to the understanding of presence and its relation to corporeality. A classification scheme is proposed and applied to an empirical study of listening in real and simulated environments.

Keywords--- **listening, sound, presence**

1. Introduction

It is well documented that sound is a vital component is creating a sense of presence. To take some of the major dimensions, sound is better present rather than absent [1, 2]; sometimes better spatialised than not, as in [2, 3, 4, 5]; and, generally, the more realistic (or perhaps plausible) the better. Sound is also used in a manner which aims to evoke a location or event, rather than simply reproducing it, or a particular mood (as discussed, *inter alia* in [6] and [7]), in common with other forms of mediated experience such as (video) games or in or movies. For example, Kubrick's use of Ligeti's requiem in *2001: A Space Odyssey* successfully transported us to the depths of the solar system while John William's theme music for *Jaws* created an extraordinary sense of dread respectively.

However, the systematic exploration of the complementary domain of the phenomenology of listening has not received as much attention by the presence community. To date relatively few research reports have appeared: typical among these are [8] which discusses sound and musical performance in virtual environments and observed that "familiarity, context, and developmental or physiological significance clearly have a substantial impact on sound reception", [9] which treats prior listening experience as a nuisance variable; [10] which investigates how near-field audio displays may, for instance, allow discrimination of urgent and non-urgent warnings, sounds nearer the head being interpreted as more urgent, or to increase the perceived intimacy of an experience by presenting sounds as apparently very close to the listener; and [11] which discusses the role of expectation in auditory experience. A more substantive consideration, however, of listening and hearing is provided by [4] and we return to this in section 2.

1.1 Measuring responses to sound in presence research

References to audition and listening do, however, appear regularly in the various questionnaire instruments developed to assess presence, but listening is generally treated as an un-nuanced activity. In the most widely applied and/or systematically validated scales, we find the sound related items listed below. For example, the PQ [12] includes:

- How much did the auditory aspects of the environment involve you?
- How well could you identify sounds?
- How well could you localize sounds?

While Nichols *et al.* [13] poses the question:

- Whilst you used the game, music played in the background. How much attention did you pay to it?

The reality judgment and presence questionnaire [14] asks the following:

- How clear were the sounds in the virtual world?
- To what extent were the voices or other perception from outside the virtual world congruent to what you were experiencing in the virtual world?
- To what extent did what you heard and the quality of the sound in the virtual world

influence how real the experience seemed to you?
- To what extent did the sounds influence how into the virtual world you went?

The remaining three questionnaires pose only one question each: ITC-SOPI [15]:

- I had a strong sense of sounds coming from different directions within the displayed environment.

Dinh *et al*. [16] *and* IPQ [17]:

- How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?

SVUP [18]

- To what extent were you able to identify sounds?

Interestingly neither the Kim and Biocca [19], the SUS questionnaire [20] nor the MEC scale [21] contain any specifically sound-related items and listening is conspicuously absent.

2. Listening

In contrast to the above treatment of audition, Gibson [22] argues that the perception of sound involves listening not just passive hearing. And it is to listening we now turn our attention. We begin with a consideration of listening with reference to our bodies before discussing the ways in which different forms of listening have been classified. This section concludes with an outline of the Heideggerian concept of "throwness" applied to listening.

2.1 Listening and Corporeality

Sound is not merely (potential) sensory stimuli, a source of auditory information - it is information. In the same way, Gibson also distinguishes between two functions of the auditory system:
- Extero-receptive – this collects information on the direction of the sound event, its orientation, the nature of the event giving rise to it;
- Proprio-receptive – this collects and processes sounds made by the individual (e.g. speaking, breathing, sniffing).

The listening system comprises the ears which collect sounds and through the movement of the heads collect information on their direction[1]. The auditory system processes information concerning the intensity, pitch, direction and duration of the sounds but this is not confined to the ears. The interpretation of auditory information is always with reference to the body. At a the simplest level, our corporeality allows us to locate sound – above, below, in front – behind and in doing so identifies the location of our bodies. While the ear may be the most obvious focus of our audition they are not the sole source of information.

Rodaway [23:91] notes that the body has its own auditory presence, "*both explicitly through the vocal chords and implicitly in the friction of its movement (internally and against the external environment) and, most importantly , its own biorhythms which allow us to measure the pattern of sounds (rhythm, pace, duration). Auditory perception is against this corporeal background and in reference to it.*" The auditory world is experienced as it surrounds us and as participants in it.

Auditory space is, however, quite different from visual space. Hull [24] notes that "Sound places one with a world." Similarly Ihde [25] notes that we are at the edge of visual space and consequently at a distance, in contrast we are also at the centre of the auditory experience. This is all neatly summarized by Carpenter (cited in Rodaway, *ibid*: 114) as follows, "*Auditory space has no favoured focus. It is a sphere without fixed boundaries, space itself (soundfield) not space containing a thing. It is not pictorial space, boxed-in, but dynamic, always in flux, creating its own dimensions moment by moment. It has no fixed boundaries, it is indifferent to background. The eye focuses, pin-points, abstracts, locating each object in physical space against a background; the ear, however, favours sounds from any direction*".

Listening is thus not only a matter of localising sounds but also places us in space through its inherently corporeal grounding.

2.2 Classifying different modes of listening

Sound and listening has been the subject of much attention in the film community, and here Sonnenschein [26], an authority on cinematic sound design, notes the active nature of listening, entailing filtering, selective focus, links to memory and the capacity to respond. Sonnenschein cites the film theorist's Chion's three listening modes: reduced, concerned only with the parameters of a sound and not its source or meaning; causal, where the listener is identifying the sound source; and semantic, relating to the spoken language or other symbolic codes [27]. To this Sonnenschein adds a further mode, referential listening, which implies links to the emotional connotations and meaning of the sound as well as an awareness of its context

In presence research, we find a similar framework underpinning the argument in Murray [4] for the significance

[1] Many animals have the added luxury of being able to swivel their ears too.

of sound in immersive virtual environments. Following Gilkey and Weisenberger [1], Murray adopts Ramdell's three levels of hearing as a framework to discuss an empirical study of induced hearing loss and its implications for VE design. Ramsdell's three levels are *social hearing* which concerns communication, *warning hearing* which relates to sounds that indicate something happening – the ring of the doorbell, or the boiling of the kettle and *primitive hearing*, relating to background sounds of which we are not normally consciously aware [28]. In Ramsdell's view, primitive hearing is essential for *psychological coupling*, that is, the sense of active connection with the environment. Murray's results indicate that support for both warning hearing and primitive hearing are necessary for a sense of presence in VR, with the addition of social hearing in the case of shared environments.

2.3 An Alternate Classification

While several elements of the descriptions of listening just described overlap, other useful points are unique to single accounts. Drawing on the work of [26, 27] in film theory, [28] in the study of deafness and [1] and [4] in presence research, and taking the corporeality of listening into consideration, we propose a three level account:

1. Pre-listening. This is pre-conscious and is prone to rapid habituation. The listener is not normally aware of sounds in this level of listening, but can comment on them if asked to do so ("there is a buzzing sound"). Sounds are not consciously attributed to their sources. Pre-listening is equivalent to Ramsdell's *primitive hearing*, and Chion's *reduced listening*. We also include such things as the startle reflex, alerting the body to potential threats – this is the most ancient from of listening phylogenetically.
2. Object-event listening: this might equally be described as *everyday listening* [29], *causal listening* [27] and would include Ramsdell's warning hearing (this is at a higher level than the startle reflex). In object-event listening we typically recognize and locate the sound source relative to our bodies and are able to judge the size and shapes of objects. ("the sound of a heavy door closing behind me", "the sound of a cat meowing a long way off").
3. The final category we describe as sense-making listening. This final category of listening involves is built upon object-event listening but involves making sense of the sound and often includes affective, autobiographical or perhaps social elements. Thus, ("the sound of a door closing, which means it must be about 6.30pm as that's when my wife returns from work"). Similarly "the sound of a cat meowing" becomes – the sub-vocalized "he's not hungry again is he?" . The category is similar to Sonnenschein's *referential listening*. This is also the body in social context (*cf.* "the intentional arc"). Listening to speech or other forms of audible communication would fall into this category, but are not of primary concern in this context.

2.4 The "Thrownness" of Listening

Listening, like its visual equivalent – looking, is as we have seen active, intentional hearing. A consequence of these active, involved and directed senses is that they have the attribute of "thrownness". "Thrownness" is a term introduced by the phenomenological philosopher Martin Heidegger [30] and used to describe the way in which moods are disclosed (become known)[2]. Dreyfus [33: 174] helpfully notes that "Moods provide the background on the basis of which specific events can affect us". If I am in a bad-tempered mood, everything is annoying to me. Moods colour our view of the world and events and reveal how things are going with us - i.e. moods reflect things back to us. Things, whether we are seeing or listening to them, are encountered as attractive, appealing, boring, tiresome and a dozen other things and there is no way in which they can appear neutral. The "thrownness" of listening compels us to have the world disclosed to us in a manner which reflects our moods. (The language of Heidegger may be difficult but the points he makes are invaluable). In all, this is why listening is so compelling, and its interpretative function so central.

We now turn to a small-scale empirical investigation of the phenomenology of listening.

3. The empirical study

The work reported here is part of a larger study examining the relationship between sound, sense of presence and sense of place in real and artificial soundscapes, of which other aspects have been reported elsewhere [34]. Our hypothesis in this instance was that the 'thrownness' of listening is such that all three forms of listening would be evident even in conditions where the soundscape is clearly artificial. The part of the study discussed in this paper had two conditions with 10 participants assigned to each:

1. Participants physically present in the Jack Kilby Computing Centre at Napier University (JKCC) (fig. 1.) The JKCC is a 500 seat, 24/7, very busy, open-access computing facility.

2. Participants located in a different room and seated at a table among in the midst of eight speakers and four sub basses reproducing the JKCC soundscape. See figure 2.

[2] Winograd and Flores [31] are usually credited with introducing a number of Heidegger's concepts including ready-to-hand, thrownness and present-at-hand to the computing world and Zahorik and Jenison [32] have briefly discussed the concept in the context of presence. It should be said that in consulting the source material (Heidegger's *Being and Time*) it is a little difficult to reconciled their interpretation with the original.

The soundscape itself was recorded in the JKCC. An eight channel system was used. Omni directional tie-clip microphones, using suspension mounts, were placed in an ellipse, at 1.3m in height (the approximate head-height of a seated listener). Spacing of microphones was chosen to correspond to the loudspeaker positioning during reproduction, so time delays would match. A thirty minute recording was made at 96kHz, 24 bit. This higher recording rate enabled a wider range of harmonics and a greater dynamic range to be recorded than is possible with normal CD rates (44.1kHz, 16 bit). This provides a theoretical frequency range of 20 Hz – 48 kHz and 0 – 148 dB, compared to 20 Hz – 22.05 kHz and 96 dB when using CD rates. The higher settings allow the recording of the more subtle aspects of the soundfield associated with the reverberation of the room, which is typically contained within the higher complex harmonics. The increase in the dynamic range also captured the quieter sounds, which are normally lost in the noise floor of recording equipment. It also allowed the accurate capture of transient peaks without the requirement for compression. The result of this is that the increase in rates more accurately reflects the experience of actually being in the environment, as a listener's hearing capabilities are typically well beyond that associated with any commercially available recording system.

The reproduction system employed a compact loudspeaker in place of each microphone and four sub bass monitors in order to extend the frequency range for lower frequencies. This was located in a quiet room and the positioning of each compact monitor matched exactly the original microphone positions. The reproduction system was calibrated to sound pressure levels made during the original recording. Participants listened to a continuous 15 minute extract from the recording, whilst sitting on a height adjustable chair which raised their ears to height of 1.3m, which allowed accurate alignment with the centre of the loudspeakers.

Figure 1: the real JKCC

3.1 Participants and procedure

Twenty participants were invited to participate in the study and were randomly assigned to one of the two conditions. The participants varied with respect to their age, sex and background. All participants took part in the study on a voluntary basis and all had a high command of spoken English.

In both conditions participants were seated and requested to verbalise what they heard, as they heard it, during the fifteen minute session. They were informed that the session would last for about fifteen minutes and that they could ask any questions afterwards. They were also told that they could end the experiment at any point. Verbalisation was recorded using a microphone attached to the participant's collar. In condition 2 (artificial soundscape) participants were not informed of the location where the recording had been made. A questionnaire adapted from the widely used Slater-Usoh-Steed instrument [20] was administered at the end of the session. This included an item which focused on the memory of the auditory aspects of the experience of being in the JKCC.

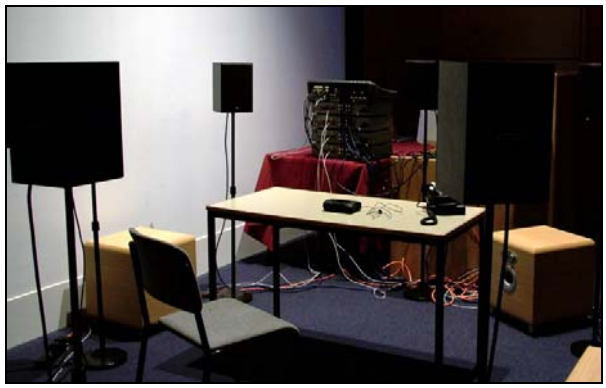

Figure 2: recreating the JKCC

3.2 Analysis and Results

Transcribed verbalisations were coded for one of the three forms of listening by the second and third authors, a sample of coding being cross-checked for consistency and reliability. There was evidence of all three forms of listening in both real and artificial conditions. Table 1 shows the number of participants making each type of verbalisation. All participants verbalised instances of object-event listening. In the real soundscape, the verbalisations of one of the ten participants were limited to object-event listening and a further four verbalised object-event and sense-making listening only. In the artificial condition, three participants verbalised object-event and sense-making listening only. There was further variation between individual participants in the *proportion* of verbalisations for the different forms of listening but the data here requires further analysis.

	Real soundscape	Artificial soundscape
Pre-listening	5	3
Object-event listening	10	10
Sense-making listening	9	10

Table 1: Number of participants verbalising each type of listening in the real and artificial soundscapes

The following are representative examples of verbalizations of each type of listening:

Pre-listening

"Slight peeping noise" (Real soundscape)
"General background hum" (Real soundscape)
"Full of ambient noises" (Real soundscape)
"Lots of banging noises" (Real soundscape)

"General quite low noise" (Artificial soundscape)
"Continual clicking" (Artificial soundscape)
"I can hear tapping" (Artificial soundscape)
"The elements of the background noise, they are changed from being such a low drone to being a higher pitched noise" (Artificial soundscape)

Object-event listening

"But mostly it's typing and keyboards" (Real soundscape)
"Constant sound of paper being binned" (Real soundscape)
"There's a mobile phone somewhere and some laughing coming from back there somewhere" (Real soundscape)
"Could be photocopier sounds as well" (Real soundscape)

"I can hear people walking about now" (Artificial soundscape)
"Sounds like someone opening curtains or blinds" (Artificial soundscape)
"Must be walking downstairs… walking along a wooden floor and then onto a carpeted floor" (Artificial soundscape)
"Someone scrunching up a bit of paper and then throwing it away" (Artificial soundscape)

Sense-making listening

"And a lot of coughing, as if everyone has a cold at the same time" (Real soundscape)
"A girlie laughter – someone reasonably attracted to someone else" (Real soundscape)
"Still talking to a pal... and the noise is annoying behind me... still making noise" (Real soundscape)
"The beeping of the computer getting terribly upset" (Real soundscape)

"It sounds like I am sitting in an office somewhere – some high-ceilinged office" (Artificial soundscape)
"It's really quite annoying actually" (Artificial soundscape)
"Must be a place where everybody is very unwell... coughing and sneezing keeps going on." (Artificial soundscape)
"Sounds like people typing and just working in an office, I think" (Artificial soundscape)

Both conditions also generated a number of verbalisations which placed the listener corporeally in the soundscape.

"I'm next to the stairs, so you can hear the people walking up and down as well" (Real soundscape)
"More steps behind me" (Real soundscape)
"Laughing on my left" (Real soundscape)
"Somebody using a mouse on my left" (Real soundscape)
"Just a few people behind me slightly to my left" (Artificial soundscape)
"More hammering away on my right" (Artificial soundscape)
"Someone exhaling… a low voice whispering directly behind me." (Artificial soundscape)
"More tapping to my left again." (Artificial soundscape)

4. Discussion

Although this is a small, preliminary study, the results do suggest that the listening experience in the artificial soundscape was very similar to the real experience. All three forms of listening were evident in both conditions, participants in the (very evidently) artificial condition still being able to make sense of the sounds, relate them to their bodies, their own experience and affective state and the perceived intentions and affect of others. It is also striking that the throwness of listening compels people to interpret the soundscape about them despite the artificiality of the setting.

Instances of pre-listening are comparatively uncommon in both conditions. This is not surprising: (i) we were asking people to comment on something which is normally pre-conscious and (ii) the act of complying with a request to describe what they heard is likely to have prompted ascription of a source to the sound – object-event listening. We are considering how pre-listening might be captured more effectively.

There are also relatively few examples of sense-making listening, but (by inspection) no systematic difference between conditions. There is, however, a notable difference between individuals in the relative proportions of object-event listening and sense-making listening, and in ego-centric localization of sounds. It is unclear how far this reflects

differences in listening behaviour, verbal adeptness, expressive style, spatial ability or other cognitive characteristics. We have observed similar features before in analyzing free-form verbal responses [35]: disentangling the 'nuisance' effect of individual differences remains an issue for presence research. In this instance a within-subjects comparison between conditions would have been a possibility, but this would have in turn raised issues around the effects of familiarisation. More interestingly, the data from the presence questionnaire from the participants in the artificial condition suggests that a relationship may exist between forms of listening and perceived presence – we would hypothesise that sense-making betokens a greater degree of intentionality, engagement and hence, conceivably presence – but with only 10 participants a further study is necessary before this can be more than a weakly indicative finding. Such further work would be facilitated by the development of a quantitative 'listening scale' which would complement qualitative data collection.

5. Conclusions

This work has argued that, as listening locates our corporeal selves in the world, and the 'thrownness' of listening is so compelling, a consideration of listening is an important element in presence research. We have drawn on previous work to define a three level classification of listening and applied this to an empirical study of real and artificial soundscapes. We have so far identified evidence of all three forms of listening in each condition. Further work is required to replicate this work with a larger scale study and with other soundscapes, to identify the relationships between dominant modes of listening and presence, to operationalise the three-fold descriptions as a measurement scale and to explore how best to support all three forms of listening in virtual environments. Finally, on a more theoretical plane, there are some parallels between the three levels of listening proposed here and the three-layer model of presence described in Riva *et al*. [36] which would repay further consideration.

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7. References

[1] Gilkey, R. H., & Weisenberger, J. M. (1995). The sense of presence for the suddenly deafened adult. *Presence: Teleoperators and Virtual Environments*, **4(4)**, 357-363.

[2] Hendrix, C., & Barfield, W. (1996). The sense of presence within auditory environments. *Presence: Teleoperators and Virtual Environments*, **5(3)**, 290-301

[3] Stanney, K.M., Mourant, R.R. and Kennedy, R.S. (1998) Human factors issues in virtual environments. *Presence: Teleoperators & Virtual Environments*, **7(4)**, 327-351

[4] Murray, C.D., Arnold, P. and Thornton, B. (2000). Presence Accompanying Induced Hearing Loss: Implications for Immersive Virtual Environments. *Presence: Teleoperators & Virtual Environments*, **9(2)**, 137-148.

[5] Bormann, K. (2005) Presence and the Utility of Audio Spatialization. *Presence: Teleoperators & Virtual Environments*, **14(3)**, 278-297

[6] Robertson, J., de Quincey, A., Stapleford, T. and Wiggins, G. (1998) Real-Time Music Generation for a Virtual Environment. *Proc. ECAI 98 Workshop on AI/ALife and Entertainment*.

[7] Sheridan, T.B. (2004) Musings on Music Making and Listening: Supervisory Control and Virtual Reality. *Proc. IEEE*, **92(4)**, 601-605

[8] Pressing, J. (1997) Some perspectives on performed sound and music in virtual environments. *Presence: Teleoperators & Virtual Environments*, **6(4)**, 482-502.

[9] Storms, R. L. and Zyda, M. J. (2000) Interactions in Perceived Quality of Auditory-Visual Displays. *Presence: Teleoperators & Virtual Environments*, **9(6)**, 557-580

[10] Brungart, D. S. (2002) Near-Field Virtual Audio Displays. *Presence: Teleoperators & Virtual Environments*, **11(1)**, 93-106

[11] Chueng, P., Marsden, P. (2002) Designing Auditory Spaces to Support Sense of Place: The Role of Expectation. Position paper for *The Role of Place in On-line Communities* Workshop, CSCW2002, New Orleans.

[12] Witmer, B. G., & Singer, M. J. (1998) Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, **7**, 225-240.

[13] Nichols, S., Haldane, C., & Wilson, J. R. (2000) Measurement of presence and its consequences in virtual environments. *International Journal of Human Computer Studies*, **52**, 471-491

[14] Baños, R. M., Botella, C., Garcia-Palacios, A., Villa, H., Perpina, C., and Alcaniz, M. (2000) Presence and reality judgment in virtual environments: A unitary construct? *CyberPsychology and Behaviour*, **3**, 327-335.

[15] Lessiter, J., Freeman, J., Keogh, E. and Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators & Virtual Environments*, **10**, 282-298.

[16] Dinh, H. Q., Walker, N., Song, C., Kobayashi, A., & Hodges L.F. (1999). Evaluating the importance of multi-sensory input on memory and the sense of presence in virtual environments. *Proceedings of the IEEE Virtual Reality 1999*, 222-228.

[17] Schubert, T., Friedmann, F., and Regenbrecht, H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments*, **10**, 266-281.

[18] Larsson, P., Västfjäll, D., and Kleiner, M. (2001) The actor-observer effect in virtual reality presentations. *CyberPsychology and Behavior*, **4**, 239-246.

[19] Kim, T. and Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. *Journal of Computer-Mediated Communication*, **3(2)**, no page numbers.

[20] Slater, M., Usoh, M., & Steed, A. (1994). Depth of presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, **3**, 130-144.

[21] Vorderer, P, Wirth, W., Gouveia, F. R., Biocca, F., Saari, T., Jäncke, F., Böcking, S., Schramm, H., Gysbers, A., Hartmann, T., Klimmt, C., Laarni, J., Ravaja, N., Sacau, A., Baumgartner, T. & Jäncke, P. (2004). MEC Spatial Presence Questionnaire (MECSPQ): Short Documentation and Instructions for Application. Report to the European Community, Project Presence: MEC (IST-2001-37661)

[22] Gibson, J. J. (1966) *The Senses Considered As Perceptual Systems*. Boston, Houghton Mifflin.

[23] Rodaway, P. (2001) *Sensuous Geographies*. London: Routledge.

[24] Hull, J. (1990) *Touching the Rock: An Experience of Blindness*. London: SPCK Publishing.

[25] Ihde, D. (1976) *Listening and the Voice*. Athens: Ohio University Press.

[26] Sonnenschein, D. (2001) *Sound Design: The Expressive Power of Music, Voice and Sound Effects in Cinema*. Studio City, CA: Michael Wise Productions.

[27] Chion, M. (1994) *Audio-Vision: Sound on Screen*. New York: Columbia University Press.

[28] Ramsdell, D. A. (1978). The psychology of the hard-of-hearing and deafened adult. In H. Davis & S. R. Silverman (Eds.) *Hearing and Deafness* (4th ed). New York: Holt, Rinehart & Winston, 499-510.

[29] Gaver, W. W. (1993) How do we hear in the world? Explorations of Ecological Acoustics. *Ecological Psychology*, **5(1)**, 1-29.

[30] Heidegger, M. (1927/1962) *Being and Time*. (Translated by J. Macquarrie & E. Robinson) New York: Harper Collins.

[31] Winograd, T. and F. Flores (1986) *Understanding Computers and Cognition: A New Foundation for Design*. Norwood NJ, Ablex.

[32] Zahorik, P. and Jenison, R. L. (1998) Presence as Being-in-the-World. *Presence: Teleoperators and Virtual Environments*, **7(1)**, 78-89.

[33] Dreyfus, H. L. (1991) *Being-in-the-world: A Commentary on Heidegger's Being and Time, Division 1*. Cambridge, MA: MIT Press.

[34] Turner, P., McGregor, I., Turner, S. and Carroll, F. (2003) Using Soundscapes to Create A Sense of Place. *Proc. Int. Conference on Auditory Display*, Boston, MA, USA, 6-9 July 2003.

[35] Turner, S., Turner, P., Carroll, F., O'Neill, S., Benyon, D., McCall, R. and Smyth, M. (2003). Re-creating the Botanics: towards a sense of place in virtual environments. *Proc. Of UK Conference on Environmental Psychology*, Aberdeen.

[36] Riva, G., Waterworth, J. A. and Waterworth E. L. (2004) The Layers Of Presence: A Bio-Cultural Approach To Understanding Presence In Natural And Mediated Environments. *CyberPsychology & Behavior*, **7(4)**, 405-419.