Telling People About Virtual Places: A Qualitative Perspective

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Abstract

This paper presents an investigation into how sound can be used to create a sense of place (that is, the sense of being in that particular place). In the study, people were asked to speak aloud and tell us what they could hear. The analysis of these concurrent verbalizations is a particular focus of this work. We also demonstrate the usefulness of this data and offer a novel interpretation based on the work of the phenomenologist Martin Heidegger.

1. Introduction

Qualitative methods, though increasing in popularity, are still not widely used in Presence research. The norm has been to adopt quantitative techniques, the most frequently used of which is the questionnaire. The questionnaire, as an instrument for investigating presence, has a great number of advantages, not least of which they are easy to administer, score and code while being (potentially) valid and accurate. However the use of questionnaires have been the subject to a number of criticisms [1]. Of these, there is one irrefutable objection to their use is that they are necessarily administered after the event. As the event in question is being present (i.e. in a virtual environment) a questionnaire can only elicit impressions and memories of 'how it *was*', rather than 'how it *is*'. While this objection does not in any way invalidate a role of questionnaires, there is clearly a place for a more immediate method for determining an individual's sense of presence while *in situ*. In response to these difficulties a series of *objective* measures have and are being developed and these include such things as physiological measurements [2,3].

The approach to a more immediate and situated appreciation of presence presented in this paper is based upon the elicitation and subsequent analysis of verbal protocols, which have been concurrently vocalized during a VR / presence episode. The use of *talk-aloud* or concurrent vocalization is widely used in other human-computer studies, which are briefly reviewed in section 2. However before this review we wish to highlight our intention to extend their use in two ways. Firstly, we do not wish to confine ourselves to a purely cognitive interpretation by assuming that these verbal protocols are merely the contents of the individual's working memory [4,5]. Instead we believe (and will demonstrate) that they

contain both phenomenological and reflective / cognitive elements. These phenomenological elements will give us insight into what people can see, hear and feel at that time in the virtual world – in short how they are *coping* with it and what they are *telling* us about their experiences. While the reflective or cognitive statements might witness the individual making sense of the experience with reference to their prior experience and memories.

We do, of course, recognize that the very process of concurrent vocalization may interact with whatever processes are involved in being present in a virtual environment. Indeed it is reasonable to expect that concurrent vocalization may degrade task performance, particularly if the task involved working memory or linguistic reasoning. However Ericsson and Simon (*ibid*) have argued that this is not the case and they have reviewed a number of studies, which appeared to support their position. Despite this, there is evidence to the contrary. Russo, Johnson and Stephens [6] have demonstrated that concurrent vocalization does reduce the accuracy of mental arithmetic, which is a typical working memory-intensive task (incidentally it also seems to improve the accuracy of a gambling task). Given the demands of a VR / presence episode we might speculate that the production of VR / presence may actually increase an individual's sense of presence by increasing the sense of being *involved*.

The second extension to standard use of verbal protocols concerns their analysis. Typically, as will be seen in the next section, verbal protocols are taken to be indicators of (cognitive) information processing such as: decision making or spatial reasoning. While not denying the value of the human information processing paradigm, we wish to propose and explore the usefulness of a complementary phenomenological interpretation. In many ways this is quite an ambitious undertaking: using, in this instance, Martin Heidegger's existential-phenomenological philosophy to understand how people cope with and experience a technologically mediated experience is no small matter.

2. Cognition, Coping, and Verbal Protocols

The technique of protocol analysis of verbal data has been employed within cognitive psychology and human computer interaction (HCI) research for almost 30 years. As we have seen, concurrent verbalizations are taken to

be representative of that individual's cognition, specifically, the contents of the subject's working memory. Perhaps the keyword here is 'cognition' – if an individual is engaged in cognition - then this argument holds, but if they are not, what then? Alternatives to cognition might include – daydreaming, being distracted by an itch, feeling hungry or engaging in a routine activity. Adopting this complementary phenomenological perspective may give us additional insights into the immediate contents of an individual's consciousness while engaged with virtual reality.

2.1   Cognition and Reflection

Conventionally, the elicitation of verbal protocols involves asking a person to articulate (speak aloud) what they are thinking as they perform a task. Thus, collecting verbal protocols reveals both what a person is thinking, and how people are coping with the situation or task. Detienne and Soloway [7] describe the insight as a 'sort of window onto subjects' processing strategies'. Part of the appeal of verbal protocols lies with their usefulness in revealing an individual's problem solving, or coping behaviour [8]. Using the technique, it is possible to infer a participant's cognitive processes. The requirements of the problem-solving task will direct what information is processed by the subject. Concurrent verbalization articulates that information processing (Ericsson and Simon *ibid*). As an example, verbalizations made during software debugging could be expected to reveal the various factors considered by the person as potentially contributing to a bug. Similarly, verbalizations made during software maintenance could highlight the hypotheses considered and rejected in the process of formulating an understanding of the software.

2.2   A Phenomenological Treatment

Dennett [9] distinguishes between *phenomenology*, which is the study of phenomena and *Phenomenology*, which refers to a family of the philosophical schools of thought. The former is concerned with describing experiences as they appear in consciousness, without recourse to explanation, theory, or other assumptions. Phenomenological psychology, for example, is concerned with the study of personal experience, and subjective perception of phenomena rather than 'objective truths'.

Dennett suggests that these phenomena can be grouped into (1) experiences of the 'external' world such as sights and sounds; (2) experiences of the 'internal' world such as daydreams, talking to oneself and (3) affect – pains, hungers, and emotional responses such as surprise or desire. While these very different experiences could be divided and partitioned in a dozen different ways we can (probably) agree that they are direct (i.e. unmediated), subjective, personal and qualitative in nature.

Phenomenology may also be defined as the interpretive study of human experience, the aim of which is to examine and clarify human situations, events, meanings, and experiences "as they spontaneously occur in the course of daily life" (as noted on page 3 [10]). The goal of phenomenology is "a rigorous description of human life as it is lived […] in all of its first-person concreteness, urgency, and ambiguity" (page 5, [11]).

Phenomenology is also the name of a number of different but overlapping schools of philosophical thought. These schools of phenomenological thought can be broadly divided into two traditions[1], namely those which draw upon the writings and thoughts of Edmund Husserl (transcendental phenomenology) and of Martin Heidegger (existential phenomenology) respectively. Since our interest here is existential in nature, Heiedegger's work is the more relevant of the two. We take two things from Heidegger and his later commentators and phenomenological researchers: (i) everyday, practical coping (ii) Heidegger's treatment of language from the perspective of telling.

2.3   Everyday, Practical Coping

By practical coping, Dreyfus (a philosopher and influential commentator on Heidegger) means the mostly smooth and unobtrusive responsiveness to circumstances that enables human beings to get around in the world. Everyday, practical coping is not necessarily cognitive and may only invoke cognition when some form of breakdown occurs. The scope of practical coping extends from the mundane such as using a knife and fork, sitting working at a desk, to the highly skilled such grandmaster chess or writing an academic paper. Tools and devices are central to coping and these are often used as a backdrop to other activities: talking on a mobile phone while irritating the other passengers on a train; holding a conversation while tying a shoe-lace; typing a letter while drinking a cup of coffee and a thousand other combinations – including wearing an HMD while concurrently vocalizing.

Dreyfus clarifies Heidegger's basic theses as:

1. People have skills for coping with equipment, other people, and themselves;
2. Our shared everyday coping practices conform to norms;
3. The interrelated totality of equipment, norms and social roles form a whole which Heidegger calls "significance."
4. Significance is the basis of average intelligibility, and
5. This average intelligibility can be further articulated in language. As Heidegger puts it "We have *the same thing* in view, because it is in *the same* averageness that we have a common understanding of what is said" (Being & Time 212).

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[1] We are confident that many philosophers will disagree with this rather simple treatment of a complex topic.

While the language of Heidegger and Dreyfus may be a little unfamiliar, what is apparent is that our everyday coping with the world, tools and technology is the basis by which we make sense of those things we are using. We share a common understanding with respect to tools and equipment and this intelligibility can be articulated in language.

2.4   Heidegger, Language and Telling

Heidegger [12] has noted "It is language that tells us about the nature of a thing …". In the same essay, Heidegger, demonstrates at great length, how language, and the use of language affords insights into the nature of being-in-the-world. However for the purposes of this discussion we now turn to his treatment of *telling*. The reason for this is captured in the following trio of cryptic-sounding observations which Heidegger offers in his *Being and Time* (abbreviated to BT), " The … foundation of language is discourse or talk' and 'Discourse is existentially equiprimodial with state-of-mind and understanding' and finally, 'The way in which discourse gets expressed is language'(BT 161).

Drawing heavily on Dreyfus' commentary on *Being and Time* to understand these assertions – we note that Heidegger argues that while talking is the foundation of language, by *talking* he actually means *telling*. He uses the German word *Rede*, which Dreyfus prefers to translate as 'telling'. 'Telling' should be understood as in the expression 'to tell the time', or what a bank teller does or being able to tell that an image is upside down or a surgeon telling apart different kinds of tissue. All of which indicate that 'telling' is not necessarily linguistic, instead telling is about picking out and pointing out significations in the world which is then manifest as language. Or as Heidegger puts it himself, "Discoursing or talking is the way in which we articulate significantly the intelligibility of being-in-the-world" – linking us back to everyday practical coping.

The next point is further revealing, Heidegger argues that discourse (telling) does not precede or follow state-of-mind or understanding it occurs concurrently (it is equiprimodial). To illustrate this, the following fairly long quotation from Heidegger should help:

"What we "first" hear it is never noise or complexes of sounds but the creaking wagon, the motor-cycle. We hear the column on the march, the north wind, the woodpecker tapping, the fire crackling. It requires a very artificial and complicated frame of mind to 'hear' a 'pure noise'. The fact that motor-cycles and wagons are what we as being-in-the-world already dwells alongside what is ready-to-hand within-the-world; it certainly does not dwell proximally alongside 'sensations'; nor would it first have to be given shape …" - BT 164.

Heidegger writes in much the same vein on the issue of vision and visual perception.

In summary, Heidegger argues that much of our being-in-the-world can be characterized by everyday practical coping (and cognitively mediated behavior when required). The processes of coping reveal or disclose the nature, structure and significances of the world. These significances can also be articulated by means of language, which is built upon telling which occurs equiprimodial with understanding.

So if people concurrently vocalize while enjoying a technologically created world what can they tell us about this world?

3. Listening to people

For the purposes of this study we have sought to investigate the extent to which we can create a sense of place using a soundfield alone. This study continues the work we have reported elsewhere [13] into the role of sound in recreating real places.

3.1   Capturing and recreating a soundfield

A custom eight-channel digital audio recording/replay system, was utilized in order to reproduce the central computing lab at Napier University (Jack Kilby Computer Centre) during a typical afternoon.

Figure 1 - Capturing the sound of the Jack Kilby Computer Centre

The recording involved eight identical omni-directional tie-clip microphones, with subsequent speaker positioning matching the microphones in both floor position & height (figures 1 & 2). These were positioned into an ellipse at approximately average ear-height when seated, in order to emulate the majority of the inhabitants' positions. Omni-directional microphones were chosen in order to maximize any natural reflections as well as to ensure that nothing was "off-axis" such as is the case of directional microphones.

The recording was made in a single thirty-minute pass onto eight separate channels, a separate eight channel microphone pre-amp was used to minimize distortion and ensure consistency in both dynamics and frequency. Each channel was recorded at 96kHz and 24 bits, which gave us an theoretical dynamic range of 144 dB ensuring that the full audible range was covered. The high sampling rate meant that not only could ultrasonic frequencies be recorded, ensuring that associated phase cancellation could be reproduced, but also that the short

Figure 2: recreating the JKCC

time delays, with an accuracy of circa fifteen microseconds, that we rely on in order to accurately locate sounds could be reproduced, something which is not possible at the standard CD sampling rate of 44.1 kHz.

Calibration between the physical soundscape and its subsequent reproduction was achieved utilizing a sound pressure level (spl) meter. The meter was set to the C scale and recorded an average of c.48dBC, the A scale would have rolled off too much bass, whereas the C scale more accurately represents the acoustic energy present during the recording. For reproduction eight compact monitors were supplemented by four sub bass units, whilst bass transmission can normally be considered omni-directional, the low spl levels made accurate positioning of low frequency sounds, such as people walking on hollow resonant floors, difficult. The use of four sub bass units solved this problem, achieving a more accurate representation, than that normally associated with a 5.1 or 7.1 system, where the sub bass unit is normally located in front of the listener. This also compensated for the reduced frequency transmission range associated with compact monitors. When participants were describing the virtual soundfield they were recorded using a standard stereo tie-clip microphone onto a DAT set to 48kHz 16 bit, this allowed an accurate stereo image in order to emulate the participant's listening experience with reference to their own voice.

3.2   Participants

Forty participants were invited to participate in the study and were randomly assigned to one of the four conditions. The study was conducted over a period of two consecutive weeks. The participants varied with respect to their age, sex and background. All participants took part in the study on a voluntary basis, and all were required to have a high command of spoken English.

3.3   Experimental Conditions

The study had four conditions with 10 participants randomly assigned to each condition:

Condition
1	Participants were physically present in the Jack Kilby Computer Centre (JKCC) while being asked to speak aloud what they could hear for 15 minutes.
2	As condition 1 but with the participants having been blindfolded.
3	Participants were exposed to a recreated soundfield of the JKCC for 15 minutes. They were asked to describe speak aloud what they were hearing.
4	As condition 3 but with the participants having been blindfolded.

In order to prevent the responses from the physical environment being merely a reflection of what participants could see and therefore interpret, half of the respondents were blindfolded. In a similar manner half of the participants who experienced the recording were also blindfolded to prevent the knowledge of the loudspeaker positions affecting their responses. This allowed us an insight into whether knowledge of the reproduction system would affect the responses, which it subsequently did not.

3.4   Procedure

For all conditions a stereo microphone was attached to the collar of each participant in order to record what

they said aloud. A Sony DAT Walkman™ was used to record their words. The participants were told that the task would last approximately fifteen minutes and that they could ask any questions afterwards.

For conditions 3 and 4 the participants were guided into a room and seated at a table where they were asked to listen to the recording and describe what they could hear for 15 minutes. They were also told that they could end the experiment at any point. For condition 4 they were blindfolded and unaware that they would be seated in the midst of eight speakers and four sub bass units (see figure 2). After fifteen minutes, they were guided back out of the room and their blindfold was removed. At no stage during the experiment, could the participant see the room and its contents.

4. Data Analysis

The recorded verbalizations were transcribed and read. The transcribed text files were then analyzed using ATLAS/ti[2]. Perhaps the most striking finding was the degree of individual differences within each condition, for example, here are two extracts from two participants:

```
00:00:06 to 00:00:17
Voices ... paper crunching ... more
voices...

00:00:24 to 00:00:26
Maybe the wind...

00:00:49 to 00:00:51
No changes still voices

00:01:14 to 00:01:16
Someone is coughing in the background

00:01:26 to 00:01:27
More people coughing ...

00:01:41 to 00:01:46
Its like sitting in some kind of...
railway station or something
```

This protocol is fairly laconic, mainly phenomenological ('paper crunching') intermixed with more interpretative statements 'kind of … railway station'. In contrast, the second extract is much more cognitive or reflective.

```
00:00:00 to 00:00:29
It sounds like a station it sounds like
Waverley station[3] ... although it could be
a corridor ... Ammm ... fell a bit lost
sitting still when everyone else is moving
around and getting on with their stuff ...
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```
00:00:49 to 00:01:00
Now I'm trying to listen to what the
people behind me are saying ... amm ...
and it feels strange 'coz they're talking
in another language and it feels like I
should be listening ... some sort of
buzzer...

00:01:08 to 00:01:14
Its like a tape sound. ticking that's
probably the tape ...

00:01:21 to 00:01:47
that sounds like somebody pressing keys,
typing ... coughing ... that sounds like
I'm in an office... it just feels pretty
normal ... like you ... like you were
sitting in an office... always worrying
when you hear someone laughing and you
don't know what's its about

00:01:53 to 00:02:08
sounds like somebody opening curtains or
blinds... or even taking photos... which
is a bit disconcerting
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These two participants both commented on what they were hearing (voices, typing, laughter) and occasionally produced an interpretation of those sounds (like a railway station or a corridor, ticking that's probably the tape) very much in line with what we expected. These verbal protocols are not just the contents of peoples' working memories but reflect what they are hearing and how they feel which is what they are *telling* us about.

To make sense of these data we have chosen to identify themes. This standard qualitative approach has been used successfully both by the authors and others ([14, 15]). To this end the protocols were re-read independently by the authors until we were reasonably confident that we had identified a number of recurrent themes. At this point we compared notes and eschewing the use of a statistical test[4] to quantify the level of agreement agreed a set of themes. In all forty-five themes were identified, we present six of them by way of illustration.

4.1 Theme 1: the environment

A consistent and persistent theme in many of the verbal protocols is that the real and recreated JKCC is a noisy environment. These phenomena correspond to Dennett's first category, namely, experiences of the 'external' world such as sights and sounds. However we

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[2] The software supports qualitative content analysis of text, images and audio material, in particular the selection, coding annotating and comparison of segments of raw data. A semantic network editor allows the building and modification of theoretical models.
[3] The central railway station in Edinburgh.

[4] The use of Cohen's κ to quantify the level of agreement is occasionally used in these circumstances but the test is not without its critics. Given that our intention is to *illustrate* the usefulness of the technique of concurrent vocalization and its analysis rather than to make claims about the experiment itself we decided against applying the test.

note that individuals' vocalizations are a mixture of the phenomenological and the more reflective.

```
P 3: Jane - 3:4 (10:10)
You can tell it's a large room cause a lot
of the sounds are very far away

P 3: Jane - 3:37 (95:95)
You can tell that I am sitting at the end
of the hall because the noise is coming
from the left hand side and at the right
hand side there is a wall

P 9: Renney - 9:26 (62:62)
I have a feeling its quite a large space
... as well ... am I don t know if that's
to with the any kind of echoic or not but
it feels quite eerie and perhaps its
because I know where I am ... so I've got
visual pictures to go with the sounds ...

P14: Roy - 14:18 (43:43)
Mmmh its very difficult to work out what
kind of a space it is ... it feels like I
am about fifteen or twenty feet away from
most of the sounds

P20: Gus - 20:17 (45:45)
They are noises you would expect to have
in our lab ... a computer lab or a place
where they have computers
```

4.2   Theme 2: Reflecting on the experience

There was also abundant evidence of people stopping and reflecting on the experience of listening to and concurrently verbalizing the experience too.

```
P 9: Renney - 9:25 (62:62)
Am I'm trying to think whether the sounds
are distracting or not... ammh its not too
bad at the moment some times it is really
nippy if you have got a couple of
people... am sitting next to you and they
are just not intended to do any work at
all... they are just sort of chatting away
and that's very distracting ... but at the
moment most of the sound talking... sounds
quite purposeful... am it doesn't sound to
much like people trying to avoid work ...
so it's a ... I wouldn't find it
particularly distracting ...

P18: Michael - 18:7 (18:18)
I would be fairly content to work in this
environment ... it's not a ... not
distracting it has got a sort of buzz
which doesn't pull me away from what I'm
thinking about

P 7: Nigel - 7:52 (59:59)
things are getting noisier well it seems
that way anyway must be getting used to it
or something ...
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P11: Alice - 11:51 (110:110)
an interesting experience ...very much
like what a blind person must feel when
they get moved into an environment that
they are unfamiliar with and they are
trying to grasp at every cue that they can
to make sense of it.

P13: Edgar - 13:20 (59:59)
Not only have I been spared any shrieking
or anything like that... I have not heard
any mobile phones yet

P16: Spike - 16:19 (45:45)
If I were in a room and this was happening
around me, I would be looking at something
else to do... I'm getting bored...
whatever that is going on doesn't seem to
involve me... I would be looking around to
either get out or look for something to
read... or somebody to talk to...
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4.3   Theme 3: My body

While a number of commentators – particularly Maurice Merleau-Ponty [16] – have stressed the importance of the body in experiencing the world, we found relatively few examples.

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P28: Macduff - 28:20 (57:57)
Constant tapping of my feet as well

P39: Shalto - 39:82 (113:113)
I hear myself talking out loud ... I hear
myself sniffing ...

P23: Bentall - 23:7 (16:16)
Quite often, I can hear my own clicking
mouse.

P30: Paul - 30:35 (67:67)
I can hear some [indistinct] people
talking ... I don't think I was meant to
say that as loud as I did
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4.4   Theme 4: Clicking, tapping and ringing

Classically phenomenological in character, our participants remarked on these minor intrusions frequently.

```
P 5: Matt - 5:25 (52:52)
Mobile phone ringing ... or something like
that

P 5: Matt - 5:38 (82:82)
Somebody closing a bag or something like
that ... making sound

P 6: Mark - 6:12 (25:25)
Sounds like a pen being clicked ...

P12: Eileen - 12:17 (40:40)
Maybe it's somebody stapling things
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P16: Spike - 16:27 (63:63)
Scrunching noise behind me... is moving
from left to right... somebody... crisp
packet...

4.5 Theme 5: Sex

Heidegger spoke of us being *thrown* into the world, that is, our inability not to be involved. We are constantly sense-making and telling apart male from female.

P 2: Grace - 2:54 (34:34)
a female voice is coming from the right
... behind but quite close ...

P 2: Grace - 2:55 (34:34)
that was the Gus right in front of me ...
still speaking constantly ...

P 5: Matt - 5:11 (16:16)
now I hear somebody talking over there I
can't really ... to the right of me ... I
can't really hear what she's saying ... a
girl talking ...

P 7: Nigel - 7:68 (80:80)
Cough same guy

P10: Stephan - 10:28 (18:18)
a phone going off... she's just answered
it ... girl speaking a foreign language...
to the left of me ... she keeps talking...
she still talking ...

P11: Alice - 11:44 (98:98)
more female laughter there...

P18: Michael - 18:18 (42:42)
I can hear two girls talking behind and to
my... right and I can all most make out
the words... and so I am trying... am what
I am saying is... am ... it's because I
can almost pick out the words that I'm
unconsciously trying to listen to them

P29: Orlando - 29:38 (46:46)
a girlie laughter... someone reasonably
attracted to someone else... hope they
can't hear me ... and there is the
returned laughter... classic flirtation

4.6 Theme 6: "What was that?"

This theme captures the experience of telling that something had happened but not being quite sure what.

P 7: Nigel - 7:13 (20:20)
Somebody setting something down on a
desk...

P11: Alice - 11:40 (86:86)
I am still baffled by the background
sounds

P12: Eileen - 12:12 (25:25)
That sounds like something dropped on the
floor

P16: Spike - 16:57 (105:105)
Somebody has just dropped something on the
left and again

P22: Aspel - 22:16 (43:43)
Ugh ... don't know what that noise was.

P31: Ben - 31:35 (48:48)
Don't know what that noise is

P32: Douglas - 32:29 (69:69)
And there was something falling down

P34: Usha - 34:40 (64:64)
something clanking shut...

5. Discussion

This paper set itself a number of different tasks. The first was to introduce the concept of the concurrent verbalization (CV) an established technique within the computing community, and to extend its use beyond the reflective / cognitive to include the phenomenological. Concentrating on Heidegger's treatment of telling allows participants to disclose the nature, structure and significances of their auditory world in real time. When subsequently time-coded the speak-alouds allow cross-referencing with the original sound events illustrating how participants cope with and make sense of the virtual world, throughout the experience.

Examples of qualitative thematic analysis were illustrated resulting in forty-five separate themes from forty participants. What can be shown, is that there is engagement on lots of different levels, considerably more than just cognition. These recurrent themes allow participants to tell us what they hear and how they feel about it, providing us with key factors which are required in order to recreate effectively a sense of place.

6. Further work

The next step is to compare the results with work that the second author is currently conducting with professional audio practitioners. Designers of virtual audio are predominately concerned with the technical aspects of dynamics, spectrum and so on, whereas listeners are trying to make sense of their soundscape. This method could be refined by either giving the listeners tasks such as "please identify how many people are in the room" or asked specific questions about where a specific sound source is within the environment.

Additional work also needs to be conducted about the nature of where the participants experience the sound sources as emanating from. In this experiment participants listening to the recording would find it emanating mostly from behind them, while others would experience it mostly coming from the front or left and so on. This was despite the system being calibrated and the

seating position being identical. This effect has been realized for some time within the film industry but further work is required in order to evaluate the effects within VR [17].

Further study should also be made into the effect of the participant's voice when speaking having different acoustic effects than the recorded soundfield. This can be rectified by passing the participant's voice through an appropriate reverberation unit in order to recreate the effect of speaking in the environment under study. This should partially eliminate this mismatch in a manner similar to hand replication when using data gloves within VR.

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