Listening Together-Apart: On the Social Mediation of Sound Installation Listening

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Abstract

Enacted across the disciplines of sound art and HCI, this paper explores physical behaviours associated with sound installation listening and their mediation by social factors. It presents an ethnomethodological study conducted during the public exhibition of an ultrasonic installation, *Being With The Waves*. Inaudible to the naked ear, the artwork is heard via custom headphones and, as an experience, manifests differently for individual listeners according to their spatial orientation to speakers, body position, movement, and perceptual behaviour. Arguably, the installation is *antisocial* by design, foregrounding private rather than collective experience. However, up to six listeners may experience it together, creating a social dimension that inevitably mediates behaviour. An interaction analysis of video observations identifies important ways in which the physical behaviour of listeners appears to be mediated by the presence (or absence) of other people in the exhibition space. The study's findings indicate that the local social dynamic strongly impacts how listeners move and use their bodies, which affects the discovery and exploration of spatial and interactive effects. Critiquing the study from a feminist new materialist perspective, methodological changes are considered that might connect social behaviours with the material design of the installation and foreground situated knowledge.

CCS Concepts

• **Applied computing** → *Sound and music computing*; *Media arts*; • **Human-centered computing** → *Interaction design theory, concepts and paradigms*; *Empirical studies in interaction design*; *Field studies*.

Keywords

ultrasound, installation, listening, sociality, ethnomethodology, feminism, entanglement

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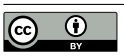

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1 Introduction

It is widely acknowledged in HCI and interactive art research that a person's experience of technology is strongly influenced by its context [6, 9, 47]. Lab-based studies do not account for conditions that emerge in public exhibition spaces, nor the influence of social factors. This paper describes a research study conducted during the presentation of an ultrasonic art installation called *Being With The Waves* during *Ramsgate Festival of Sound* in September 2021.

Being With The Waves is, arguably, *antisocial* by design, foregrounding private rather than collective experience. Inaudible to the naked ear, the artwork is heard via custom headphones and, as an experience, manifests differently for individual listeners according to their spatial orientation to speakers, body position, movement, and perceptual behaviour [51, 52]. Unlike interactive sound installations such as *DETOUR* [14] and *SoundPlay* [48], *Being With The Waves* is not designed to instigate social interactions between members of the public. However, during a public exhibition, up to six listeners may experience the installation simultaneously, creating a social dimension that inevitably mediates behaviour.

The research study reported in this paper was designed to explore listener engagement, physical behaviour and their mediation by the public exhibition context. Taking an ethnomethodological approach, the installation space was filmed to observe behaviours and, inspired by interactive art research [8, 12, 16], visitors were invited to complete a short survey about their experience of the artwork. In this paper, we report primarily on an interaction analysis [39] of video observations, occasionally drawing survey data into the discussion to explore potential reasons for observed behaviour. Our findings identify important ways in which the physical behaviour of listeners appears to be mediated by the presence (or not) of other people in the exhibition space. Our analysis indicates that the local social dynamic has a strong impact on how listeners move and use their bodies, which in turn impacts the extent to which they can discover and explore spatial and interactive effects of the installation.

The title *Listening Together-Apart* is intended to capture the interplay of private listening with collective experience in *Being With The Waves* and is also a direct reference to the work of the feminist theorist and physicist Karen Barad [3]. It has been more than 3 years since our work on this study was completed in the early stages of a PhD project. Since then, the underlying theoretical and philosophical frameworks that underpin the research project have shifted. Seeking an epistemological alignment between the phenomenon of sound installation listening and research methods, the feminist perspectives of Donna Haraway and Karen Barad have been adopted, thereby acknowledging that (like listening), knowledge is situated

in relation to social, material and temporal contexts [28] and co-produced by research methods or apparatuses [2]. Writing from a present-day perspective and informed by relational perspectives, we close the paper with a critical reflection on the findings and research methods employed in the study.

This paper contributes insights into the mediation of interactive listening behaviours by the local social milieu and makes methodological and theoretical contributions summarised below:

(1) The application of ethnomethodology to the domain of sound art listening, where there are few outward expressions of social interaction and the observations consist largely of simple movement behaviours: standing, walking, rocking, and occasional dancing. Our interaction analysis contributes a shorthand method for transcribing listener movements through the exhibition space.
(2) A series of insights demonstrating the social mediation of listening behaviours. We find listeners largely adopting an inward focus while also co-regulating the shared space and mirroring the behaviour of other listeners present.
(3) Drawing existing literature on the phenomenology of headphone listening into the discussion, we speculate on the connections between the installation's design and listening behaviours, highlighting the lack of shared sonic space as potentially discomforting for listeners.
(4) The study was conducted from a third-wave HCI [10] social constructivist perspective. Via a methodological critique informed by a fourth-wave HCI [22] feminist and relational perspective, we consider changes to the method that might have altered our understanding of listener interactions. We propose:
   (a) An equal attunement to material (sonic and physical) and social agencies in the analysis
   (b) A commitment to situated knowledge that foregrounds the contingent quality of findings and acknowledges the active entanglement of the researcher with knowledge production.

2 Background

> 'Ever since sonic artworks have incorporated sound in contemporary art museums, scholars have either looked at the materiality of these sounds, or sought to read them conceptually. Consequently, little is known about the ways in which museum visitors actually listen to sounding artworks' - Semmerling [59].

The work described in this paper is interdisciplinary, enacted across and between [46] the disciplines of sound art[1] and human-computer interaction (HCI). It responds directly to the absence of research describing encounters of ordinary listeners with sonic artworks within sound art discourse. While it is an interdisciplinary field, sonic arts research is grounded in the humanities and foregrounds documentation by artists and theorists (e.g. [17, 49, 65]). In recent years, authors have noted the absence of empirical, qualitative studies of sound art experience. Semmerling [59] states that 'a lot remains to be learned through empirical investigations of visitors' actual listening experiences.' Keylin [40] notes that ethnographic observations and interviews with audiences could address the question of how listeners act upon the affordances of participatory sonic artworks.

These aspects are more thoroughly explored in the technology-oriented fields of interactive art and sonic interaction design, where user studies are conducted to understand how aspects of design impact the reception of artworks. Researchers have explored audience interaction with sound installations via observation, video recordings and interviews with participants [21, 23, 56]. Studies in these fields seek to articulate aspects of design that support active engagement with an artwork; for example, to understand how an 'unwitting' bystander might become a 'witting' participant [5, 60].

2.1 Research In Context

It is widely acknowledged across HCI and interactive art research that a person's experience of a technology is influenced by its context of use [9, 47]. Hutchins [37] notion of 'cognition in the wild' has been influential [36, 54, 55] and emphasises that the analysis of cognition in real settings would be different to experimental settings. Benford et al. [6] emphasise the importance of studying cultural experiences in venues such as galleries, festivals or theatres where they are experienced as cultural artefacts rather than lab prototypes and as genuinely belonging to that setting. Candy notes, however, that these kinds of public art environments are 'complex and multi-layered and, therefore, not easy to control' [13]. Bengler and Bryan-Kinns [7] note many practical issues that the researcher has to attend to when conducting studies in public art contexts, such as spatial constraints, complying with institutional regulations, ethics and health and safety. Additionally, participants tend to behave differently if they know their behaviours are under scrutiny, recorded or observed by a researcher. Indeed, Costello et al. [16] found that visitors to an interactive art exhibit behaved differently under lab-based conditions compared with the general public encountering the same artwork in the context of an exhibition space. Knowingly under study conditions, 'the participants stayed longer, did more and were more careful that they had activated all the aspects of the artwork' [16].

Recognising the discomfort of many researchers with the use of the term 'in the wild' and its colonial connotations [62], we refer to these activities instead as *research in context*.

2.2 Ethnomethodological Studies of Interaction

Pioneered by Harold Garfinkel in the 1960s [25], ethnomethodology examines how social order is constructed and maintained through everyday actions and interactions. In the early 2000s, the Work, Interaction and Technology (WIT) Group based at Kings College London applied an ethnomethodological approach to the study of human interactions with technologies using video-based observational methods in public contexts. The group is responsible for influential studies of London Underground control rooms, examining tacit work practices and task coordination around technologies

[1] Sound art is a form of artistic expression that utilises sound as its primary medium and material, encompassing a wide range of practices from field recordings and sound walks to sound installations and performances. The writing of Brandon LaBelle offers a comprehensive introduction to sound art, which they characterise as practice that 'harnesses, describes, analyzes, performs, and interrogates the condition of sound and the process by which it operates' [43].

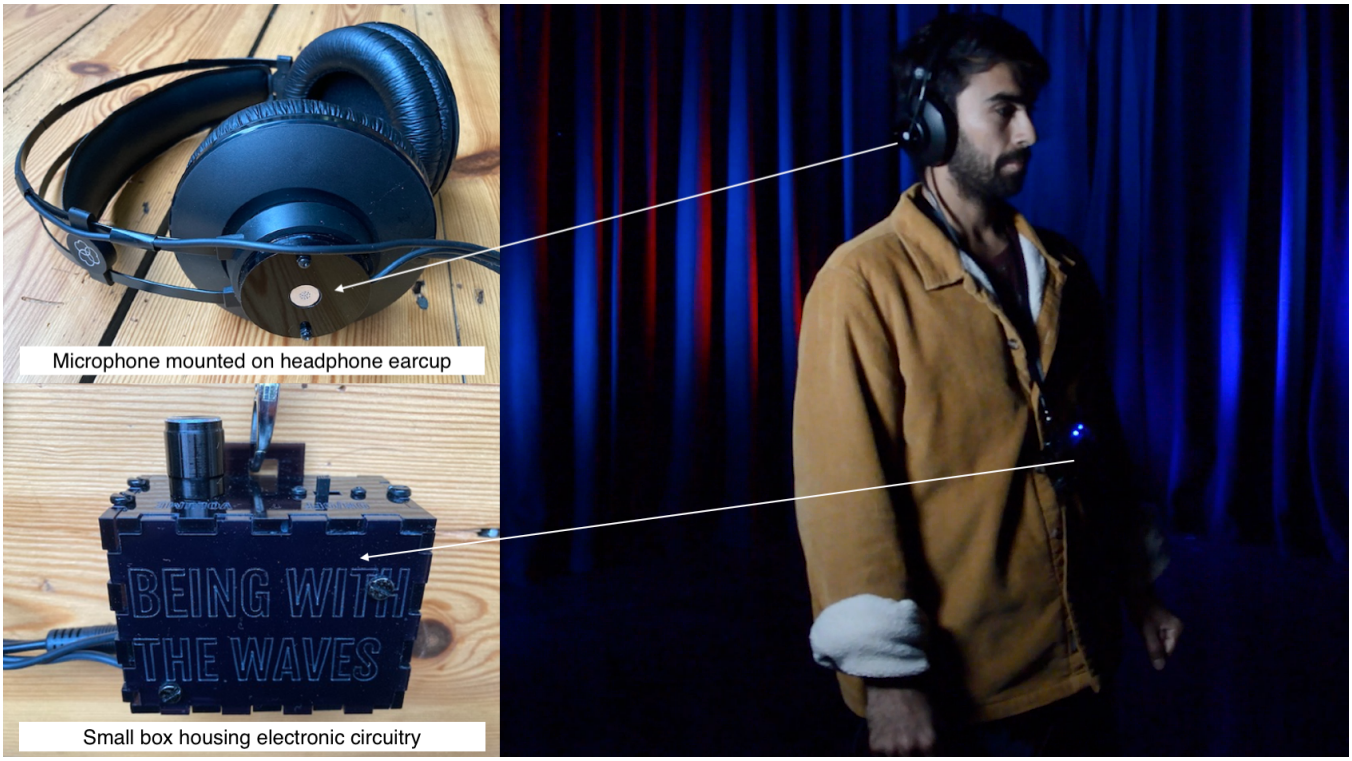

Figure 1: The modified headphone sets designed for *Being With The Waves*. Small electret microphones are mounted on the outside of headphone earcups. Ultrasonic signals are routed to an amplification circuit and Teensy microcontroller housed in the small black box. This is worn around the neck of listeners and includes an on/off switch and volume control knob.

[30, 31]. Of particular relevance to this research is the group's video-based field studies of visitor interactions with artworks and museum exhibits. Some of these studies focused on traditional artworks or historical exhibits [33, 66, 68], others examined visitor encounters with interactive exhibits [29, 34], a multi-media installation [32], Personal Digital Assistants (PDAs) and touchscreen information kiosks [67].

Each of these studies explores the ways that experience emerges 'in and through social interaction… [and] how people, in collaboration with others, reflexively constitute the sense and significance of objects and artefacts' [32]. Visitors to museums and galleries are often in a party with friends and family and share the space with other visitors, displaying 'an extraordinary sensitivity to the conduct and experience of others'. Indeed, a key finding that persists across the different studies conducted by the WIT group is how encounters with, and experience of, museum and art exhibits emerges 'in and through' interaction between people within 'perceptual range of the event' [27], i.e. not just between visitors who arrived together, but also with other people who just happen to be within the same space [69].

In a 2002 paper examining visitor interactions with a mixed-media installation called *Deus Oculi*, Heath et al. [32] found that co-visitors subtly 'configure' each other's engagement with the installation via vocal interaction, bodily gestures, or in more subtle ways. The authors suggest that how visitors move around, orient to, glance at and comment upon the installation may encourage others in the same space to notice something of interest that might otherwise have been ignored. The installation has a role to play here in that it allows visitors to make sense of the conduct of others. Their behaviours become 'sensible' by their relationship to the installation. Heath et al. [32] describes the social milieu around the installation as an ecology that emerges moment by moment in selective ways according to the conduct of people within perceptual range.

3 The Study

The following research study was designed to explore listener engagement, physical behaviour and their mediation by the public exhibition context. It addresses the following research questions:

(1) How do listeners experience a sound installation in the context of a public art festival?
(2) What do listeners do? In terms of physical behaviour (e.g. movement, bodily dispositions)
(3) How does social context mediate behaviour?

The following subsections describe the design of the study, beginning with a description of the ultrasonic art installation, before details of the public exhibition, data collection and analysis methods are given.

3.1 Ultrasonic Art Installation

This paper explores socially mediated behaviours of listening to the artwork *Being With The Waves*, which employs a novel ultrasonic technology. The installation is conceived as both an artwork and a research probe deployed in participant studies to elicit and articulate spatial and entangled listening experiences.

Technically, a multi-channel composition is composed in Ableton[2] in the audible range. Each audio track is shifted into the ultrasonic range using the technique of amplitude modulation, simply multiplying the audio signal by a sine tone of 20.5kHz using a Max4Live[3] device before it is output to an individual tweeter in the installation space. Thus, the installation physically sounds in the exhibition space but above the range of human hearing. Visitors hear the artwork via headphones. Microphones on the outside of earcups capture ultrasonic phenomena at the ear (see Figure 1), and a microcontroller shifts the signals down into audibility via the same process of amplitude modulation before outputting them to headphones.

The audio fidelity of the original multi-channel composition remains remarkably intact, but ultrasonic modulation skews the spatial appearance of sounds and results in exaggerated Doppler effects: listeners hear the audio warp and shudder in a manner that is hypersensitive and intimately connected to their bodily behaviour. There are no movement sensors, mappings or feedback loops. Instead, the experience of listening may be perceived as interactive due to the spatial arrangement of sound sources and the close entanglement of the listener with sound phenomena physically present in the air. For further technical and artistic details, please refer to [51, 52].

3.2 Public Exhibition Context

The study took place in September 2021 when *Being With The Waves* was exhibited as part of the Ramsgate Festival of Sound[4], an annual community-focused event showcasing sonic artworks, theatre and musical performances. The installation's selection in the festival was the result of a successful application to an open call for artworks to be part of the *Sonic Trail*, whereby seven sonic artworks were installed at different venues throughout the town. Visitors to the festival were given a map showing the location of each installation and could choose to walk between them. *Being With The Waves* was installed in the auditorium space at Ramsgate Music Hall[5]. The first author greeted visitors upon arrival at the venue and introduced the installation verbally using the brief curatorial text that was supplied to the festival for their marketing channels:

> *Explore sound as a fluid presence that fills the space around you and discover stories of seaborne experience woven into an immersive composition that bends and shifts with your movement. To the naked ear, the installation* Being With The Waves *appears silent, but a hidden world of voices, instrumental tones, and maritime sounds is revealed through wearing special headphones.*

3.3 Installation Arrangement

Informed by our earlier interview study with sound artists [50] and intention to explore physical behaviours associated with spatial listening, the installation was curated to emphasise the sonic dimension. The space was dimly lit and visual distractions minimised: the stage was curtained off, and signage covered. Since the venue was relatively small (32.5 m^2), a six-channel arrangement of ultrasonic transducers was chosen, with two spaced along each side wall and two placed along the centre of the space. To encourage spatial exploration by ear, the speakers were hidden from sight, placed above the eye-line and among other objects.

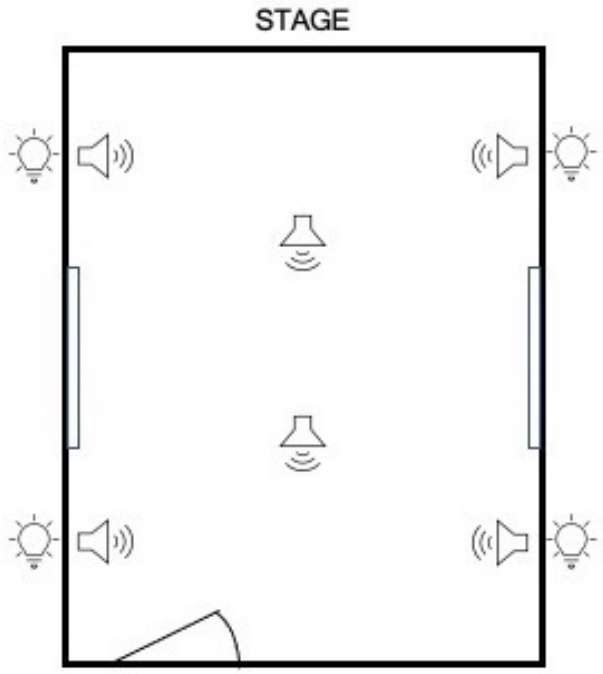

Figure 2: The installation's spatial arrangement at Ramsgate Festival

Figure 2 shows the arrangement of the speakers and house lights that were used to illuminate the installation, re-fitted with red and blue bulbs. It also shows the position of two ledges on the left and right walls of the room that are ordinarily used as places for gig-goers to put their drinks, but that were acted upon by listeners to the installation as objects to lean on or hold onto.

3.4 Practical and Ethical Considerations

The venue's layout influenced the study's design. The installation was in a separate space, and it would not be possible to observe

[2]Ableton Live is a software sequencer for producing, arranging, mixing and performing with audio: https://www.ableton.com/
[3]Max for Live devices integrate the functionality of the visual programming language Max, within Ableton Live, allowing users to create custom audio effects and instruments: https://www.ableton.com/en/live/max-for-live/
[4]https://www.ramsgatefestival.org/
[5]https://www.ramsgatemusichall.com/

Figure 3: An image of the installation space captured by the GoPro used to record video observations.

listening behaviours directly from the researcher's position in the foyer. The presence of an observer in the installation space would likely be a distraction to listeners and interfere with the social context. For this reason, it was most practical to film the installation space and make observations from the recording later.

The public context of the installation was key to the research aims. The study was therefore designed in such a way that the activities of data collection had a minimal impact on listener experiences. Context is delicate, and the intention was for listeners to approach the piece as they might any other artwork at the festival. This intention needed to be balanced with the desire to collect meaningful data ethically, ensuring that listeners' participation in the research was understood and consented to. The chosen approach was to allow visitors a free interaction with the artwork and introduce the research after they had finished listening, at which point, each listener was invited to complete a post-experience survey and consent form. During times when filming was happening, this was signposted to listeners before entering the installation. Consent was sought from listeners as they exited the installation, and only footage for which the consent of listeners was given was included in the analysis.

3.5 Visitor Logbook

A log was kept of visitor numbers and dwell times. For each new listener, the log was completed by hand with their unique listener number (e.g., P1, P2, P3…), a number (1-6) associated with the set of headphones they were given, the time that they entered and left the installation, the number of listeners in their party, and whether they completed the survey and/ or consent form. If the visitor was under 18 or in the same party as a child, the logbook was annotated accordingly.

3.6 Video Observations

A GoPro video camera was set up in the installation space to capture the whole room from a position above head height at one end of the space (see Figure 3). Since the installation is not audible to the naked ear, the video only captured visible behaviour and very occasional talking between listeners. The installation space was filmed during the Friday and Saturday of the festival.

3.7 Analysis

3.7.1 Preparation. To prepare the video footage for analysis, the files were imported into video editing software. Any periods where there were no listeners or interactions, including children or adults for whom we didn't collect consent, were removed. As the installation space was dark, the exposure was adjusted to lighten the footage and make more details visible. The edited video files were then re-exported for analysis. 3 hours and 15 minutes of video footage were analysed, including the interactions of 27 listeners.

3.7.2 Interaction Analysis. While reviewing the video, longer-term behaviours were observed that appeared to be dependent on contextual or social factors. The contingent nature of these behaviours could not adequately be accounted for through qualitative coding,

and a method informed by Interaction Analysis (IA) [39] was chosen to analyse these aspects of the data more closely. IA is a method for investigating the interactions of humans with each other and with their environment. Of central interest is how people make sense of each other's actions and collaborate to achieve locally sensible interaction.

IA is committed to an inductive mode of analysis, whereby analytic categories are developed directly through and from the observational data. The method does not impose pre-defined analytical frameworks or dictate one method or technique for undertaking the analysis. Instead, Jordan and Henderson [39] propose a series of typical foci that may guide the analysis process. The chosen foci for this analysis were the temporal and spatial organisation of listener activity and participant structures: the extent to which individuals appear to share a common orientation and attentional focus.

3.7.3 Video Transcription. Video footage was transcribed to produce a descriptive account of visible listener activities. The process of transcription entailed a close examination of the data and served to create a detailed record of behaviours that facilitated the analysis. The transcription was guided by the foci described in the previous paragraph and broken into units of coherent activity. Each of these units is denoted in the transcription by a new timecode and marked by a shift in activity (e.g. a listener begins to move their head from side to side) or shift of spatial positioning (e.g. one or more listeners move from one position to another). Within this structure for transcription, there was a particular focus on coordination among listeners: changing bodily orientation, attentional focus and distinctive movement behaviours. The transcriptions were created by the first author, then discussed and checked as part of regular supervisory meetings with the second and third authors.

A shorthand method was developed to describe a listener's spatial position in the space, dividing the installation space into a 3x3 grid, as shown in Figure 4. If a listener was observed to move from the far-left area of the room to the middle-right area, this was denoted in the transcriptions as a move from F/L to M/R.

An early observation was that behaviours appeared to depend on whether other listeners were in the space and, if so, their existing behaviours. For this reason, transcriptions were broken into phases, each corresponding to a different set of co-present listeners in the space. Therefore, for listeners who dwell in the installation for a long time, their interaction may be broken into many phases as other listeners arrive and leave the space. An example video transcription is included in Appendix A.

4 Findings

The installation could accommodate up to six listeners at any one time. Some listeners had the space to themselves, and others shared it with many others. Observing the video footage, it is clear that the behaviour of listeners is influenced by the presence (or lack of) other listeners in the space. In summary:

(1) The behaviour and body language of most listeners suggests a turning away from others in the space, towards a focus on their own perceptual experience. Yet, listeners appear to collectively negotiate the installation space to ensure that nobody's personal space is intruded upon.

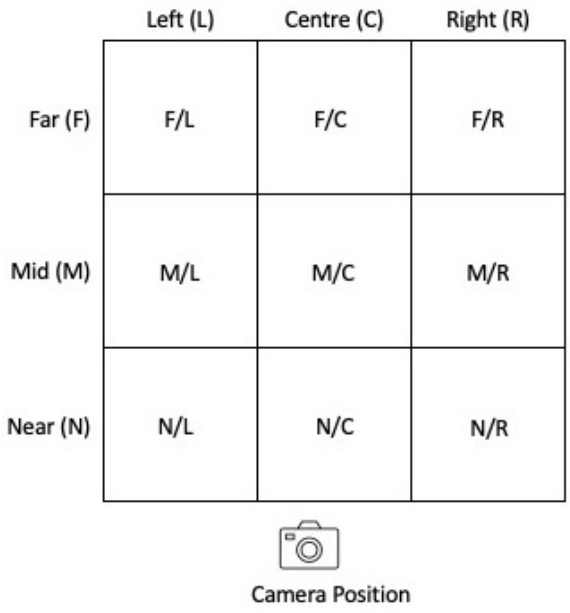

Figure 4: Dividing the installation space into nine areas

(2) Solo listeners and couples behave differently when they have the space to themselves than when it is shared with strangers. They exhibit more expressive movement behaviours, attempt to communicate, and use mobile phones to document their experience.
(3) Many instances are observed when listeners come to mirror the behaviour of listeners already in the space, for example, adopting stillness or distinctive movement behaviours.

The following section describes these observations in greater detail, providing examples from the data set in support.

4.1 Collectively Managing Shared Space

Observing the video footage, most listeners who arrive in a group move away from each other immediately as they begin to listen. They take different trajectories through the space and orient their bodies so as not to face other listeners. Many listeners bow their heads, close their eyes, or even turn to face a wall, thus excluding other listeners from their field of view: body language that suggests a 'turn inward' or the intention to focus on one's own perceptual experience over a communal or social experience.

Despite this inward focus, groups of listeners (3 or more) appear to collectively manage the shared space to ensure that the personal space and inner experience of other listeners are not intruded upon. Listeners are seen spaced evenly apart from one another and moving into parts of the room where a space has been left. The effect of this is a kind of group-mediated choreography that occurs without conscious thought – no doubt behaviour that is practised in other social situations. For example, there is a passage during phase 2 of annotations when two listeners coordinate their movement to repeatedly move between the same two points in the installation space.

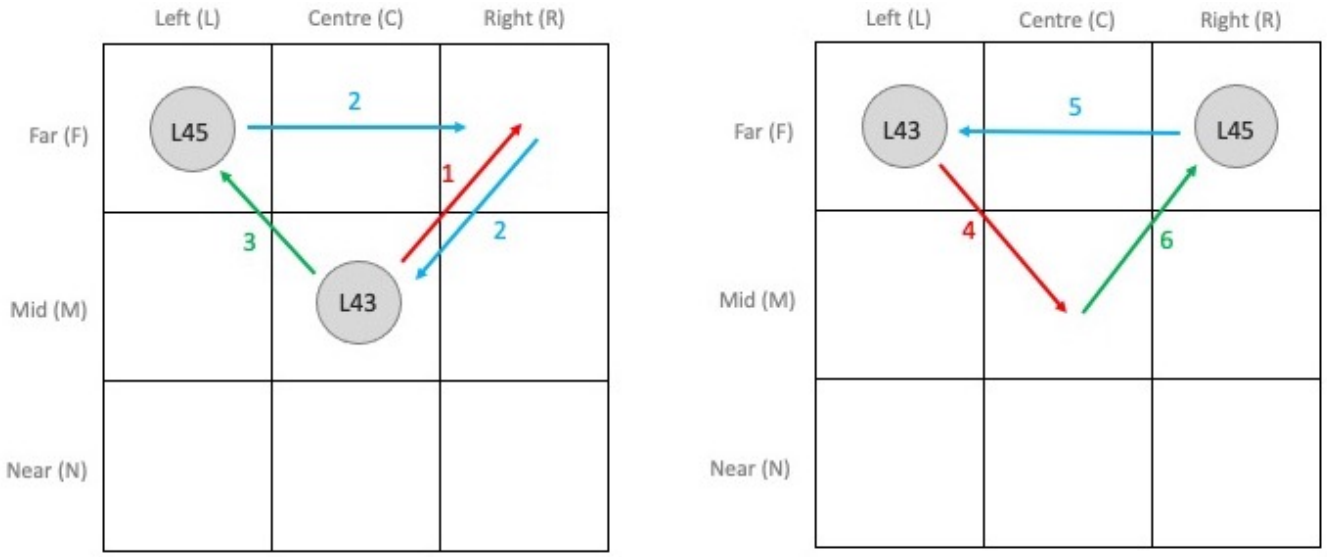

Figure 5: Diagrams showing a coordinated sequence of movements between P43 and P45

The following description is illustrated by Figure 5. Numbered arrows indicate the sequence of movements. P45 stands in the far left corner (F/L), and P43 is in the centre of the room (M/C). (1) P43 walks to the far right corner (F/R) and (2) back to M/C, as she walks back, P45 walks to stand at F/R. (3) In response, P43 walks backwards to F/L, where the other listener had previously been standing. (4) P43 returns to M/C and (5) P45 walks back to F/L. With F/R now vacated (6), P43 moves once more to that position.

If they notice they will converge with another person, a listener may change their trajectory through the space. For example, P58 walks down the right side of the room toward the front and pauses for a few moments before turning and beginning to walk back. As she does so, P59 moves toward the far right wall, and P58 adjusts her course, walking to the far left corner.

Perhaps to ensure that the even spacing and personal space of listeners is maintained, there are instances of coordinated periods of walking and standing, where one person begins to move, and this has a domino effect on the room. This occurs frequently during phase 1 of annotations. For example, at 1'42", P42 begins walking around the perimeter anticlockwise. Even though P42 is not within their field of vision, P43 begins moving <1 second later, and P44 begins walking <1 second after P43 moves. The three listeners come to a standstill at the same moment, around 12 seconds later.

4.2 Solo Behaviour is Less Inhibited

Solo listeners or listener pairs (that arrived together) who were alone in the installation engaged in behaviours that were not observed when the space was shared with strangers. In these cases, it appears as though behaviour is less inhibited or bound by social conventions. Potentially, the material context of the installation space (darkened, separate from the outside world and acoustically isolated) contributes to a sense of privacy. Some solo listeners exhibit more outwardly expressive behaviours, such as full-body dance-like movement, arm gestures, and moving more quickly or more broadly through the whole space. Solo listeners also use their mobile phones to document the experience, something that is not observed at all during periods when the space is occupied by three or more listeners. Pairs of listeners, who arrive in the space together, attempt to share the experience and communicate verbally or gesturally with each other when alone in the space. Again, this is rarely observed at times when the space is shared with strangers.

4.2.1 Expressive and dance-like movement. Listeners who are alone in the space appear more likely to experiment with playful or expressive movement gestures. For example, P53 has the installation to herself for the entirety of her interaction. After a few minutes of walking and standing, she launches into a period of dance-like movement, pirouetting through the whole space, moving at different speeds, holding and swinging her outstretched arms, at times vigorously shaking her upper body (see Figure 6). P58 dwells in the installation for 25 minutes, during which time other listeners come and go. For 5 minutes, she has the space to herself and, in this time, develops an expressive range of movement that becomes more inhibited upon the arrival of other listeners in the space. As soon as she is alone, P58 walks diagonally through the whole space and then around the perimeter before coming to the centre of the room. At first, she makes gentle rocking motions with a small range of movement. After a couple of minutes, these develop into more expressive and dance-like movements, which, although rooted to the spot, involve the undulation of the whole body. As the door opens and two new listeners enter, P58 turns to look and ceases to move expressively, choosing instead to stand still.

4.2.2 Mobile phone use. During the periods that were filmed, listeners rarely interacted with their mobile devices and the only instances of phone use were observed in the case of solo listeners, who appeared to document their experience in some way – filming, photographing or writing. After 1'32", P53 takes out her phone and, for the next 90 seconds, appears to write something. It is possible

Figure 6: P53 strikes a pose before pirouetting through the installation space

that she is using the phone to communicate – to write messages or emails – but from her thoughtful disposition, she may also be taking notes or writing about her experience. Shortly after this, she appears to select the camera application and positions the device on the floor to film herself moving in the space. She returns to check the phone and then places it back in her pocket - perhaps the filming was not successful. For the most part, P66 shares the space with two other listeners. Almost as soon as they leave, he takes out his mobile phone once to take photographs and then a second time, holding the device in front of his body while he walks, as though filming the space. Note that the mobile phone will not record the sound that the listener hears.

4.2.3 Verbal and gestural communication. Verbal or gestural communication is only observed when a pair of listeners have the space to themselves. In these cases, it appears as though the listeners wish to share the experience rather than focus only on their own experience. Again, listeners behave in ways that they would not if they were sharing the space with strangers; P73 and P74 even stop for a kiss!

At first, P64 and P65 share the space with another pair of listeners who leave shortly after their arrival. Once alone in the space, periods of more independent movement are punctuated by moments in which they come together and communicate either verbally or gesturally. For example, P64 moves to stand in front of P65 and says out loud, 'The sounds are really beautiful, aren't they?'. P65 doesn't seem to hear. He takes off his headphones, and P65 whispers this time: 'The sounds are really beautiful.' P65 responds 'mm' before putting the headphones back on again. P64 then walks to the far-left corner and turns to face P65. She makes one breaststroke swimming movement with her arms before making a brief waving hand gesture at P65 to get his attention, and they then both make coordinated breaststroke swimming motions with their arms.

As soon as P75 and P76 are alone in the room, their behaviour changes; they immediately turn to each other and communicate in whispers and using pointing gestures. In a gesture that appears symbolic of ownership of the space, they also take off their shoes. Later, P75 stretches out her arms and moves into a forward folding stretch before rocking broadly from side to side as though manipulating her hips. When P77 enters the space, the couple barely adjust their behaviour and continues to communicate with each other. Interestingly, P77 only stays for 4 minutes, and it may be that their experience is disturbed by the behaviour of P75 and P76, who continue to act as though they are alone in the space.

4.3 Behavioural Mirroring

There are many instances in which listeners adopt similar behaviours or take on the behaviours of those already in the room. Sometimes, distinctive movement behaviours become mirrored by other listeners, and at other times, co-present listeners adopt very similar, generic ways of being in the space. E.g. stillness, walking at a particular pace, avoidance of gaze, equal spacing in the room, standing together (in case of couples), in ways that are subtly different from one video phase to the next. It isn't the case that all listeners come to behave in the same way, and mirroring doesn't

always happen, but it is a noticeable feature of behaviour when many listeners share the installation space.

Out-of-the-ordinary behaviours may be contagious and become mirrored by others in the space. When P58 arrives in the space, she joins two other listeners, one of whom (P57) stands in one spot, gently swaying. P58 later adopts this style of movement, swaying and rocking gently on the spot. This, in turn, appears to influence P61, and for a 5-minute period, the behaviours of these two listeners appear to mirror each other, both making undulating or rocking movements on the spot.

Overall, listeners move through the space independently and collectively manage their spacing so that nobody's personal space is intruded upon. As noted earlier, listener couples often behave differently, and when they are alone in the space, are more likely to stand together and communicate. There are instances in the video footage when a second couple arrives in the room, and their behaviour mirrors that of the couple already present. When P64 and P65 arrive in the space, P62 and P63 turn their backs on the new listeners and walk together to the rear of the space, where they stand very close together. P64 and P65 do the same, they stand together in the near right corner.

The final phase of annotations has a very different character from any other that was analysed in the sense that all listeners adopt stillness for long periods. This phase begins when P79 and P80 arrive in the room; after first standing together at the rear of the room and turning their back on the other listener in the space, P80 walks to the M/L position, where there is a ledge on the wall. She puts down her bag, leans her elbows on the ledge and faces the wall, very deliberately shutting others in the room out of her experience. The two other listeners also adopt standing positions around the edge of the room. When P81 arrives in the space, she walks directly to a free position at the perimeter of the room and sits down on the floor. P80 then moves from her leaning posture to the floor, where she sits with her back to the wall before lying down on the floor. At the point when P82 and P83 arrive in the space, two women are sitting or lying down on the floor, and a male listener is standing leaning against the wall, all in total stillness. The atmosphere of the room clearly impacts the behaviour of these two new listeners, who each walk through the space slowly once before standing at the front perimeter of the room.

5 Discussion

The following discussion will focus on factors identified in this study, which appear to have a bearing on behaviour and experience. In particular, the discussion will focus on the influences of social context and headphone technology used in *Being With The Waves*.

5.1 Socially Mediated Listening Behaviour

A surprising finding of this study is the degree to which listeners appear to ignore others in the space and, at the same time, manage the shared space collectively, adopting similar behaviours (apparently) without realising. It was surprising to discover no examples of talk or gestural communication between listeners who arrived together in the space when the space was shared with strangers. Talk and gestural interaction only occurred when listeners needed to signal their intention to leave the space or in the case of listeners who had the space to themselves and did not share the space with strangers. This suggests that the social rules of the installation space only apply when co-listeners are present; they are socially constructed.

It appears that listeners practice 'civil inattention' (CI) in group listening situations. The concept of CI was proposed by Goffman [26] and describes the interaction of strangers in public places who pass close by to each other but respectfully act as though they have not seen each other. CI 'makes possible co-presence without co-mingling, awareness without engrossment, courtesy without conversation' [45]. CI occurs out of respect for people's privacy, for example, at swimming pools, where swimmers act like 'disinterested strangers' [58]. This has a functional purpose, allowing individuals to go about their business of exercising in the pool without distraction.

In the case of the sound installation, it appears as though CI is practised out of respect for the listening experiences of others in the space to allow each person in the space to focus on the act of listening. Like the swimming pool, there is a negotiated order to listener behaviours: a respect for personal space and a respect for the movements of others, i.e. 'if you want to move here, then I will respectfully move out of the way'. This leads to coordinating periods of walking and standing that appear choreographed due to the minuscule delay that was observed between one person initiating movement and others following suit.

Through an analysis of video footage collected during the public exhibition of *Being With The Waves*, it has become clear that social factors impact the behaviour of listeners and, by extension, their experience of the installation. Bodily movement occurs not only as a result of individual listening intentions but also as a result of between-listener interactions. This finding resonates with those of the Work, Interaction and Technology group, who argue strongly for the socially mediated nature of experience around museum exhibits and artworks. Importantly, their work reveals 'how an encounter with, and experience of, museum exhibits emerges in and through the interaction of those within "perceptual range of the event" [27], not just those who are in some sense "together", but also others who just happen to be within the "same" space.' [69].

This is the case in *Being With The Waves*, where many patterns of behaviour were observed whereby groups of listeners move around the installation in a highly coordinated fashion, often coming to mirror or adopt the behaviours and attitudes of others in the space. In the WIT studies, how co-visitors 'configure' each other's experience is often through explicit talk/ gesture between friends and family - either to shape an understanding of the artwork or to reach a shared understanding of how it works.

In this study, co-listeners configure each other's experience while practising civil inattention. It is not through explicit social interaction but via subtle cues that appear to be tacitly understood or processed without conscious thought. In the context of conversational interaction, Chartrand and Bargh's influential studies have shown that actions become unconsciously mirrored 'such that one's behaviour passively and unintentionally changes to match that of others in one's current social environment'. This phenomenon is called the 'chameleon effect' and is attributed to a mechanism known as the 'perception-behaviour link'. It is thought that 'the mere perception of another's behaviour automatically increases the likelihood of engaging that behaviour oneself' [15]. In their

experiments, this is shown to be the case between interaction partners engaging in spoken dialogue. In the context of *Being With The Waves*, this appears to occur between people who just happen to be within perceptual range of one another.

5.2 The Influence of Headphone Listening

Reflecting on the results of this study, perhaps the most striking finding is the extent to which the social context, i.e. the changing presence of co-listeners, appears to have impacted the behaviour of listeners. Given that listening in *Being With The Waves* is mediated by modified sets of headphones, it is important to consider how these devices may have shaped listener behaviours and experiences. There may be important ways in which they alter spatial perception, re-present sonic information and impact physical behaviours, which must be considered in this analysis because it affects the degree to which our findings are specific to *Being With The Waves*.

Unusually for an indoor sound art installation, *Being With The Waves* requires listeners to wear headphones. The collected survey responses included no references to the headphones and their technology, and in the video footage, listeners only rarely touch or interact with the headphones, most often adjusting the volume. Given the absence of relevant data, the following discussion will synthesise existing studies into the phenomenology of headphone listening, with video observations, survey data and our impression of the effect of headphones on listening experience in the context of *Being With The Waves*.

5.2.1 Listener-headphone relationships. Given the lack of reference to them in the collected data, it appears that the headphones were embodied by listeners and experienced as transparent in the sense that they did not call attention to themselves as objects but to the sound world given through them [38]. This resonates with everyday experiences of listening to music with headphones. We are not continuously aware of their presence on the body. Instead, it is the sound or music presented through them that is in the foreground of experience.

In *Being With The Waves*, the modified headphone sets exist to augment the listener's hearing ability and enable them to hear the sounds that exist physically in the space but are inaudible otherwise, carried by ultrasonic sound waves. Therefore, the headphones are intended to be *listened through*, rather than *listened to* as we might ordinarily relate to headphones when listening to music. From the survey data collected during the study, it is impossible to know the disposition of participants to headphone listening, i.e. whether they *listened through* the headphones to hear the sounding world around them. Where listeners engage in a spatial exploration of the installation, we might assume that they are *listening through* the headphones. However, in the case of listeners who stand in stillness and take a meditative disposition to listen, they might instead be inclined to *listen to* the headphones.

5.2.2 The impact of headphone listening on social interaction. In the video footage, it was surprising to observe the degree to which listeners appeared to turn inward and focus on their own space of experience, leading to an almost total lack of outward social interaction among listeners who shared the space. It is possible this behaviour was influenced by the fact of headphone listening. Headphones make listening a private activity, and in everyday listening situations (e.g. at work, commuting) may be used as a way to transport you away from the physical world around you. In headphone listening, we may find a place of sanctuary and homeliness [18], an escape from a noisy world full of strangers. On reflection, this transportative quality may be problematic in the context of a sound installation that is intended to make listeners more keenly aware of their physical presence in the sounding world.

Numerous studies have likened the experience and space of headphone listening to a 'hermetically sealed aural bubble' [11, 18, 35, 61]. Considering the apparent inward focus of listeners to *Being With The Waves*, it seems likely that listeners attended to their own 'bubble' rather than a shared space of experience. In the case of Walkman listening, Schönhammer argues that lived space becomes split in two – into a presence (bodily presence in the world) and absence (perceptually present in another sonic 'place'). This split is problematic in terms of social interaction while wearing headphones. Schönhammer finds that some people 'prefer to listen to the Walkman only when nobody is there, for they feel ashamed of creating the impression that they are unwilling to communicate' [57]. Similarly, participants in Bull's interview study report a feeling of being 'invisible' while wearing headphones, which acts as a kind of refuge in otherwise threatening or tedious situations: 'I do not have to be intimidated by jerky men or disrupted by lost tourists' [11].

Scientific studies have also shown that headphone listening may lead to people keeping larger interpersonal distances [44, 63] and that low-level lighting situations may have the same effect [1]. It is thought this is because people exercise caution in relation to others when there are fewer environmental stimuli to rely upon. Both headphone listening and low-level lighting are features of *Being With The Waves*. While a thorough exploration of lighting's effect on behaviour will be excluded here, it is likely an influencing factor in the way that listeners feel and interact with each other.

5.2.3 The mysterious behaviour of co-listeners. According to Heath et al. [32], people make sense of the behaviour of other visitors to a museum exhibit or art gallery 'by discovering, determining, connecting its relationship, or potential relationship, to particular features of the local milieu'. The above is not wholly possible in the sound installation *Being With The Waves*. What listeners hear in their headphones depends on their location and movement in the installation. Listeners cannot accurately make sense of other people's behaviour because they cannot know what another person is hearing or listening to. This is a scenario particular to the headphone system in *Being With The Waves* and other sound walks and installations that employ modified headphones to reveal otherwise imperceptible phenomena (e.g. [19, 42, 64]).

Ordinarily, in art and music contexts where multiple people wear headphones, e.g. a silent disco or video artwork, everybody hears the same recording regardless. In speaker-based sound installations, what you hear depends on where you are located in relation to the speakers, but you share the acoustic space with other listeners; for this reason, what they are hearing is much less mysterious. According to the survey data collected during this study, this barrier to making sense of the behaviour of co-listeners was problematic

for some respondents. P25 was 'disconcerted' to find the three other listeners in the space behaving differently to themselves – 'much more "active"!' – walking backwards and forwards'. The feeling of being 'disconcerted' might be attributable to the fact that P25 can't determine a relationship between the other listeners' behaviour and (what they hear as) the sounding piece. Similarly, upon noticing behaviour different to their own, P60 wonders whether the other listener has realised something that they haven't - 'I saw others move that made me wonder if they had heard something different to me.' A mechanism that we would ordinarily rely upon in everyday social situations - the ability to make sense of another person's behaviour by connecting it to features of the environment - lacks the information required to function. This impacted the experience of some listeners, making them more aware or 'disconcerted' than usual by the behaviour of others.

6 Methodological Critique (2025)

As noted in the introduction, this research study was conducted within a social constructivist framework, and our work has, since then, shifted toward feminist and relational perspectives. Each philosophical standpoint impacts the way that research is conducted and written about. In the following critique, we consider methodological aspects of the research that, were we to conduct the study today, either would be done differently or be given greater emphasis due to the adoption of feminist and new materialist epistemology [2, 28, 41]. Specifically, we propose 1.) an equal attunement to material (sonic and physical) and human (i.e. social) agencies in the analysis and 2.) a commitment to situated knowledge [28] that foregrounds the contingent quality of findings and acknowledges the active entanglement of the artist-researcher with knowledge production. We do so not to undermine the contribution of the study as is, but to acknowledge the development of thought since its completion.

6.1 Towards a Sociomaterial Analysis

Interaction analysis, as a methodological approach used to study social interactions in various settings, makes ontological assumptions based on social constructivism, i.e., that reality is continually produced through human interactions. Naturally, the analysis method foregrounds and captures social interaction. An attunement to relationality and new materialism allows an appreciation of how behaviour is shaped not only by social forces but how they are entangled with material agencies. Were we to conduct this study now, we would seek to include material agencies in the analysis of video observations to interrogate not only how listening behaviours are shaped by the social context but equally by the physicality of the exhibition space and, of course, by the sonic material heard via the installation headphones. The influence of the headphones was considered in the discussion of this study, but these aspects could have been drawn into the interaction analysis. This proposed wider focus enables a more holistic consideration of the installation and its listeners as an assemblage and might have allowed us to understand how the installation *works*, what it *does*, and how behaviours connect with its particular design. To quote the writing of Fox and Alldred [20], an epistemological orientation to new materialism might 'reveal relations, affects and affect economies in assemblages', with an orientation towards 'what things do, rather than what they "are"'.

The work of Hillevi Lens Taguchi[6] in the field of childhood and education studies includes practical examples of analyses that centre on material agency. Their analysis of an interview with a six-year-old boy at school explores how meaning is co-constituted by the 'matter' of the interview environment. The 'space of interviewing' is enacted by the arrangement and physicality of the table and chair: 'the table actively separates and distances the adult from the child. The table can be felt to agentially enact distance, formality and seriousness together with the adults' material-discursively performed talking.' Considering the study in this paper, we believe there are important ways in which the physical space and arrangement of the installation, entangled with the social dimension, inform the behaviour of listeners. Some of these are mentioned in the discussion of findings: the darkly lit room, the installation of headphones, and some not, such as the wall-mounted ledge that suggested to many listeners that they should lean on it and listen in stillness. Surely, many more influencing aspects of the work's materialities could have been identified had we been attuned to the potential relationship of visible behaviour with the stuff of the installation at the time of reviewing and analysing the video footage.

The most notable absence in the analysis, however, is the sounding installation. The sonic composition for *Being With The Waves* consists of a 25-minute piece of looped audio. Individual experience of the installation is determined by a listener's spatial position and movement. It wasn't practical to capture each participant's output feed from the microcontroller during the study; however, it *would* have been possible to correlate video footage with the correct loop position to conduct the interaction analysis in relation to a stereo mix of the composition. In hindsight, this was a missed opportunity, and the study outcomes express almost entirely a visual expression of listening and social interaction. Had the analysis been conducted with the sonic composition, it might have produced insights into, for example, whether groups of listeners pause or begin coordinated periods of movement in relation to sonic events and the extent to which stillness or expressive movements correlate with periods in which the Doppler effect is prominent. An understanding of how the installation choreographed group listening behaviours might have produced further actionable design insights. In defence of this misstep, we wish to point out that conventions of transcription in qualitative research methods all too often replace sonic data (e.g. an interview recording) with a mute textual representation (a transcription) for analysis. This convention, arguably, perpetuates an assumption that sonic qualities do not contribute to knowledge production. In our case, they certainly do, and if this study were to be re-run, observed behaviours would be interpreted always in relation to the sonic.

6.2 Committing to Situated Knowledge

An earlier draft of the study pointed to the situated quality of the findings as part of a limitations section, designed to acknowledge how the ability to generalise the results to wider sound installation experiences is constrained by the study. In hindsight, this was

[6] https://www.su.se/english/profiles/hillen-1.192935

an attempt to adhere to positivist conventions in HCI and frame the singular, ungeneralisable quality of findings as negating the quality and potential contribution of the research. For Haraway [28], rational knowledge claims are those that are located in relation to contexts, social positions and nonhuman agencies; 'feminist objectivity means quite simply situated knowledges'. Reading the study from this viewpoint re-frames its specificity as a strength.

Ethnomethodology is compatible with feminist epistemology in the sense that it foregrounds situated knowledge and contingent qualities of human interaction, examining how social meaning is actively constructed. We believe that a strength of this study is its demonstration that physical behaviour is co-produced by specific groups of people listening together. Were we to conduct the analysis again, we would commit to Haraway's [28] epistemic position and seek to foreground singular qualities of the findings.

Returning to this work after engaging with first and second-person [52] methods in more recent studies, we have become aware of the detachment that is enacted by video observation as a method. The method was chosen due to its prominence in the fields of interactive art research and ethnomethodology, and a third-person perspective was adopted somewhat uncritically, watching interactions from the outside, from a single fixed position. This detachment is echoed in the analysis, which is interpretative, the researcher making sense of patterned behaviours based on their social understanding, but - largely following HCI convention - their involvement is treated neutrally by the write-up. Feminist scholarship challenges traditional notions of objectivity, arguing that knowledge is always influenced by the researcher's positionality (social identities and experiences). This leads to 'strong objectivity', which acknowledges and incorporates these biases, rather than striving for a false neutrality [24, 28].

Writing from a Baradian perspective, Barla [4] suggests that the researcher ought to be treated not only as part of the research apparatus that observes phenomena but also as an apparatus that 'diffracts the forces she intra-acts with, producing difference-as-it-emerges rather than mirroring sameness'. The first author of this paper is an artist and a researcher. Supervised by the second and third authors, they created the ultrasonic installation and conducted the research. They are utterly entangled in the research, and their understanding of the installation and its affordances, accrued through sustained periods of making and composing, could have been leveraged and made active in the analysis of video observations. This would have situated the research more precisely and might have produced deeper and more nuanced insights into what is visible.

7 Conclusions and Future Work

This paper presented an ethnomethodological research study conducted during the public exhibition of *Being With The Waves* at *Ramsgate Festival of Sound* in 2021. The transcription and analysis of video footage revealed patterns of behaviour that were contingent on the social context of the installation. Notably, listeners behaved more expressively when alone in the space or with one other friend. When co-listeners were present, the behaviour appeared to be strongly influenced by the visible behaviours and attitudes of others within the perceptual range. Even though listeners practice civil inattention, they adopt similar behaviours and work together to ensure that interpersonal space is maintained. A key influencing factor may be the headphone listening technology employed in *Being With The Waves*. Discussing the findings in the context of existing phenomenological research, we speculated that the 'aural bubble' of headphone listening might have contributed to inward body language and that the lack of shared sonic reference might have produced disconcerted feelings, with listeners unable to make sense of the others' behaviour.

We characterise the social dynamic as *listening together-apart* in the sense that private listening experiences are mediated by collective social factors. In light of our present-day attunement to feminist and new materialist perspectives, we offered a critique of methodological aspects, proposing changes that we would make were we to conduct the study today. Specifically, we would seek a sociomaterial lens in the analysis and work to understand how listening behaviour is mediated by the entanglement of material (sonic and physical) agencies with social forces. This, we propose, might allow us to connect behaviour with the design and curation of the installation more readily - to understand 'what it does', which could directly inform future iterations. We also propose a wholehearted orientation to situated knowledge that embraces contingent qualities of findings and actively entangles the researcher with the production of knowledge.

Since conducting this study, the ultrasonic technology has been deployed in two further studies exploring connections between installation design and listener experiences (see [52, 53]). We speculated in this paper that headphone listening encourages introspective modes of behaviour. We could not test this assertion via a comparative study because the ultrasonic installation requires headphones. In the most recent iteration, we did, however, choose to stage the piece in a light rather than a dark space. While this was just one of many changes to the artwork, listeners did behave more socially, many collaborating with friends to make sounds and experiment with the effects of ultrasonic modulation.

We find, therefore, that the extent to which listeners are together and/or apart may be modulated not only through the technology and sound materials but also through curatorial devices such as lighting, texts and material staging. We have not yet explored the influence of spatial configuration or more complex speaker arrangements, but these characteristics would also, inevitably, influence listening behaviours and could be explored in future work. Given the absence of qualitative research concerning the experience of sound art [40, 59], much more empirical and ethnographic work is needed with a wide variety of different sound installations to progress an understanding of installation listening as contingent on the artwork and its sociomaterial situation.

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A Example Video Transcription

File: RF_Vid3.mp4
Date: 05/09/21
Phase 8 (5:17 - 10:10)
Listener(s): P58
Summary: With the space to herself, P58 explores the full area of the installation space and exhibits periods of expressive dance-like movement. Her behaviours are notably different in this phase – now alone – compared with Phases 7 and 9.

5:17 With the space to herself, P58 walks diagonally across the entire space, then around the perimeter before moving to the centre of the room.
6:06 P58 pauses and adjusts volume, takes a couple of tentative steps forward and turns around 180 degrees. 6:30 She bows her head and begins rocking gently forward and back with a straight body, shifting her weight. Then, from left to right, in the same manner. Very gentle movements, with a small range of movement.
7:24 She again adjusts volume before walking slowly toward M/L, stopping briefly to rock forwards and back. She continues, walking purposefully with a little more speed to F/R.
8:05 She spends a few moments looking up at the lights/ ceiling, then walks diagonally across the room to N/L, then to N/C, facing the right wall.
8:35 A period of more expressive and dance-like movement begins here, characterised by gentle undulating movements of the whole body.
10:10 The door opens and P58 turns to look, P60 and P61 arrive in the space. She stops moving expressively and instead stands still.

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