Imponderable Sound: Using infrasonic frequencies within sonic art installations

By

Justine Flynn

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Abstract

This practice as research project concerns the incorporation of predominantly infrasonic sound into installation art and focuses upon the critical and reflective evaluation of that which can be achieved and to what effect. The installations are used as a research output as art objects to gather qualitative insights that pertain to preconceived effects and effects that have not been preconceived from reports by research participants. In this way, the research searches for the existence of physical and psychological effects in response to infrasound as reported by seminal practitioners. Most significantly, this practice as research scrutinises Vic Tandy's *The Ghost in the Machine* (1998) finding substantial cause for enquiry given the plethora of contradictions amongst other practitioner researchers others of which, Skille and Alvin (1968) have reported therapeutic qualities in their findings and Dr. Amanda Harry (1997) who, when looking at the relationship between various infrasonic frequencies and how they affected the body, reported feelings of discomfort. The primary data gathering tool is a self devised questionnaire that pertains specifically to each installation and serves only to gather reports about participants experiences. These are valuable as categorical responses that address the incorporation of predominantly infrasound and inform my critical reflections both about existing literature and my own praxis, especially how this has been developed and may be extended in the future.

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Originally I, as a sonic artist, heard a sound, profound and when I questioned "Did I hear it?" I found that I did not. The sound that I found or perceived, I did not hear I felt. The sound I felt, an imponderable sound akin to gas and air, was nowhere and everywhere, a vibration, a sensory experience. (J Flynn 2006)

CHAPTER 1

1. INTRODUCTION

Imponderable Sound is immersive sonic art sculpture designed for the installation environment that emits infrasonic frequencies with the intention of affecting the human body both internally and externally. *Imponderable Sound* looks at sensation and the experience of sensation through haptic perception. This thesis considers both the artistic development of *Imponderable Sound* and the resultant audience experience of it.

In installation based art, immersive or other, I observed that the sense of touch was rarely considered whereas sight and sound were prevalent; perception of the sound and perception of the visual or to simply hear and see would suffice. Sound is a vibration; the mechanism of the ears receives the physical rarefactions and compressions of air particles which are then perceived by the brain. I then, as an artist, have explored another way of sensing vibrations that which is *felt* or *touched* without the physiological mechanisms of the ears, that which is felt via the mechanoreceptors of the skin and resonation of the body as haptic perception. The primary aim of this project is to develop installation based sonic art using sound that is felt and perceived haptically, a sound that could be perceived through the body and skin. Sight is stimulated with the sculptural component, hearing is stimulated with sound and infrasonic frequencies excite the body via haptic perception.

Barthes (1994) said that to hear is a passive act and to listen is a cognitive one. We use the ears to hear and the brain to comprehend and consider what we have heard and what that means to us as a viewer or audience. Within my

previous conceptual work, the audience were engaged, enticed and or coerced into decoding a meaning providing both an active and passive experience by engaging the ears, the eyes and cognition. I wondered if music composed from sound that operates below the audible would still stimulate cognitive thought when experienced in a similar way to 'conceptual' art or in the emotive nature of regular music that is perceived by the ears.

Artists such as Hope, Angliss and Gupfinger had produced artworks using infrasound for dissimilar reasons and in varied ways. Hope used bass guitars and bass amps, within performance, under seating in auditoriums and in locked rooms to create bass vibrations that had a physical effect on the audience. Angliss masked a sine wave of 17 Hz within an electronic composition in a concert setting in order to determine a specific effect based on Vic Tandy's research *ghost in the machine (1998).* Lastly, but not exhaustively, Gupfinger (2009) used a pipe and a fan within the installation space which interrelated aural sound with tactile sound to create an experience for the whole body. Whilst all were interested in infrasonic vibration and the effect that infrasonic vibration had on the body, three major roads of artistic inquiry became apparent.

The first was in the visual component, as Hope's work was a performance, Angliss' work was concert based and Gupfinger's work was installed, however none of the three aforementioned artists considered the aesthetic of the performance or installation work in the way that *Imponderable Sound* sculpture does.

Secondly, Hope was investigating the physical effect on the body that her bass music induced, Gupfinger was examining the connection of sound, space and body and Angliss attempted to substantiate Tandy's research on 17Hz. *Imponderable Sound* draws from each of these approaches in that it explores the relationship between sound, body and object, however differentiates in that Angliss masked the 17Hz frequency with other sound and did not use a solitary frequency as *Imponderable Sound* does. Hope concentrated purely on vibrating the body at incredibly loud volumes and Gupfinger used low frequency or infrasound to unite object, space and body through a pipe that was not meant to be sculptural. I also noticed a significant knowledge gap as neither artist specified which particular frequency induced changes and to what effect if any. Angliss had specified 17 Hz, in relation to Tandy's research but gave no further comment in regard to other frequencies and what effect they may have. *Imponderable Sound* draws on Angliss' work as an initial starting point, however the inquiry for *Imponderable Sound* is to develop sculpture that emits specific infrasonic frequencies beginning with 17Hz then using other infrasonic frequencies that are reported to affect the body or mind and, through qualitative and quantitative methods, survey the effect to ascertain whether the effect would be the same as other infrasonic frequencies used in the installation space or not.

Thirdly, even though Angliss' title was 'Soundless' music, there was an audible element to the sound as with Hope's and Gupfinger's: would it be possible to create sound that could not be heard only felt, sound that would induce an intended effect when experienced within the installation environment?

The aim of this research is to construct sonic art sculpture for the installation environment that incorporates infrasound. The name I give to this sonic art sculpture is *Imponderable Sound (IS)*. The significance of this research will be for academics, sonic artists and consumers of sonic art to gain an insight into the effects of infrasound on the body in a sonic art installation environment and to provide a new output, that of *Imponderable Sound* sonic art sculptures.

The research methodology used for the development of *Imponderable Sound* sonic art installations is that of practice as research, whereby practice is a method for enquiry and where my practice, in this case *Imponderable Sound* sonic art installations, are submitted as substantial research inquiry. (Nelson 2013 p9). *Imponderable Sound* installations are the invention that 'embody a distinct way of knowing the world' (Barrett & Bolt 2010 p16) in this case how infrasound is perceived in the sonic art environment and how this new understanding could impact upon future culture and society. (Smith, Dean, 2011 p248).

This project was approved by the university's ethics committee and moral principles have been carefully considered. The audience have a choice whether or not they wish to participate and are able to enter and leave the installations at anytime. The loudness of the sound will not cause harm and the frequency range, although important within this sonic art research, has only been known to cause negative effects in extreme cases such as the use of jet engines in warfare and the emission of sound by wind farms. All of which is not replicated to those types of extremes within this research.

A qualitative approach in the form of interviews and questionnaires is also adopted in this research design in order to understand participants' own experiences (Langridge 2004 p258) and to gain insight into the reported effects of infrasound within the sonic art installation environment. Quantitative methods will also be used to give a measured numerical percentage to effects.

This thesis will be written in a reflective manner and use the theories of Schon (1987), Kolb (1984) and Gibbs (1988), particularly the reflective cycle, which will aid in the development and comprehension of *Imponderable Sound* as the art object. Critical reflection into the sonic art practice and the development of *Imponderable Sound* installations, will draw together scientific reports into the effects of infrasound by Tandy, Harry, Skille and Allan, and the artistic practice of Hope, Gupfinger and Angliss and others, along with my own results into what the participants have reported. Therefore the aims of this research project are:

- To construct sonic art installations incorporating infrasonic vibrations, *Imponderable Sound*.
- To survey and analyse responses to *Imponderable Sound.*
- To determine whether different infrasonic frequencies used in *Imponderable Sound* sonic art installations will result in different audience responses.

Definition of Key Terms

Experiencer – My own term for an audience member who has experienced *Imponderable Sound* (*IS*) sonic art installations. *IS* is directed at the basic

senses, apart from smell, and is immersive, therefore an experiencer is more than just a viewer or a listener.

Delimitations

There were many directions that could have been highlighted within this research but are not. For example there is extensive literature into the effects of infrasound as sonic warfare (Goodman 2012).

Due to time limitations and resources, in this case the acquisition of a relevant oscilloscope, this research cannot accurately measure the infrasound created. It can only trust that the digitally synthesised frequency is actual frequency. Limitations of sub woofer equipment meant that the lowest infrasonic frequency that could be used was 15 Hz due to the frequency response of the Tannoy sub-woofer employed to amplify the Infrasound.

No medical equipment such as Magnetic Resonance Imaging (MRI) or Galvanic Skin Response equipment was used to measure audience responses in a scientific way as the importance lay in what the audience themselves reported about the experience of *Imponderable Sound* sonic art.

I was only able to collect data from a very small number of participants rather than a huge cross section of society with most being students between 18-25 years.

CHAPTER 2

2. METHODOLOGY

This chapter will justify why a practice as research methodology has been employed for this project. It will offer definitions of what practice as research is and how this term can further be defined more specifically. It begins with a definition by the Arts Humanities and Research Council (AHRC) which states that *practice* must be an integral part of any project. Further and more exact definitions by Smith and Dean (2011) are revealed along with Rust, Mottram and Till (2007), who argue that the AHRC definition is merely a set of conditions rather than a definition. Following this, practice as research is defined further using Frayling's three categories of 'Practice *into Art, through Art* and *for Art'* (1994 p4) and how this more advanced definition pertains to the development of *Imponderable Sound* sonic art installations.

Reflective practice is then discussed along with a description of how through reflection-in-action and reflection-on-action a chronological insight into *Imponderable Sound* is disclosed in the evaluation. Lastly, critical analysis is discussed and how this is used to validate the findings of *Imponderable Sound* sonic art installations.

Practice led research and research led practice

There are several terms used in academia that describe research that has practice as an integral part of the inquiry, these being practice-led research, practice based research, practice as research, practice through research and research-led practice and in many cases each term is used to describe a general creative practice rather than a more specific one.

The Arts Humanities and Research Council (AHRC) state that for research to be practice-led in the creative arts '... practice must be an integral part of the proposed project...' (AHRC funding Guide p5). Rust, Mottram and Till (2007) endeavour to characterise and advance the term 'practice led research' and state that the AHRC had only 'set out conditions to be met...without attempting a definition' and adopted a description that they considered basic but all encompassing which define it as research in which the professional and/or creative practices of art, design or architecture play an instrumental part in an inquiry.

Smith and Dean (2011) defined practice-led research in contrast to research-led practice. Research-led practice suggests that prior research informs the creative output and may not necessarily exist for a creative practice. Practice-led research, on the other hand, suggests, firstly that '…creative work in itself is a form of research and generates detectable research outputs' and secondly, that the processes and knowledge of creative practitioners can '…lead to specialised research insights that can then be generalised and written up as research'. The first statement suggests that the creative practice itself is pertinent to the research, where as the second suggests 'insights, conceptualisations and theorisations' are gained when the artist engages and records their individual progress and development of unique creative practice.

Whilst these 'catch all' terminologies describe two broad approaches to creative practice and research, it is necessary to further define the creative and practical

contribution to knowledge and understanding which will account for various practitioner-researcher approaches.

Research into art, through art and for art

Frayling (1994 p4) adapted Herbert Reads model of education into three categories or different ways to define creative practice, these being 'research into art', 'research through art' and 'research for art.' He explained that research *into* art can involve historical or aesthetic research or research into different theoretical perspectives on art such as social, political or cultural and leads primarily to a new understanding or advancement about that practice.

Research *through* art would focus on the materials used or development of work such as the advancement or adaptation of technology to operate in a way it has never has before and with the addition of action research, whereby a diary tells a step by step guide of a practical experiment, along with a report that contextualises it. This in turn generates new insights and perspectives which are relevant to understand a wide range of cultural phenomena and offers an insight into the process of art. It highlights new artistic products, outcomes or relationships and uses senses, sensations and intuitions in order to do this. Research through art uses the creative intervention as a way to form relationships between the object/act in order to understand the world in which we live.

Finally, research *for* art is about the artefact itself as the end product, the artefact becomes the embodiment of thought in itself and the use of practice

along with the outcomes are used to gain new knowledge in respect of the performance or exhibition.

The art installations

Imponderable Sound sonic art installations are exhibited and are the culmination of my creative practice as a sonic artist, practice being the integral component to this research. Research *through art,* that is, the materials used for the sculptural aspect of *Imponderable Sound* are essential for the production of sound timbre through the reverberation of the materials as well as the use of digital technology to produce infrasonic frequencies. The advancement of *Imponderable Sound*, that is by the combination of materials alone and how to reverberate that material, along with the production of digital infrasonic qualities are fused together to operate in a way that becomes the new artistic 'product' as defined by Frayling (1994). Further to this, the exhibition and installation of *Imponderable Sound* sculpture is then used to generate new insights and perspectives about the phenomena of the effects of infrasound on the body within the sonic art installation environment. Reported feedback into the sensation of the effects of *Imponderable Sound,* through the sense of touch within the installation environment, will highlight the relationship between the sculptural component, infrasound and its effects. This research seeks to provide new perspectives on existing knowledge that considers the effect of infrasound as well '...materialising a different knowledge practice'. (Sjoberg & Hughes 2015).

Further to this, research *through art* will allow me as the artist to gain an insight into the effects of *Imponderable Sound* with particular reference to sensation or

sensory experience. This research is more than practice based, as the artefact or sonic art sculpture is not the only contribution and again more than a ‘practice led’ classification as the research is not just an enquiry primarily about the practice or an advancement of knowledge solely about the practice.

Questionnaires

It is important to state here that I am an artist who is interested in how Infrasound affects the body within the installation space or environment. It is not the effects on my body as an artist that interests me, it is the experience of those who enter into *Imponderable Sound* installations and how they reportedly respond to that experience that is important to this research. Through interviews and questionnaires I will become more aware of how *Imponderable Sound* is reportedly perceived, which will then allow me as a sonic artist to compare the reports and the intention.

To ascertain whether or not an intended effect of infrasound will be reported back by the audience is an important aspect of this research. The reports of the experience are then interpreted by myself in order to further and develop the notion of *Imponderable Sound*.

The advantages of this qualitative research are, as stated by Langdridge (1983 p15) that it will ‘recognise the subjective experience of the participants, produce unexpected insights, enable an insider perspective and will not impose a particular way of ‘seeing’ so as to focus upon what is meant from the text in relation to the audience experience. Quantitative research methods that tend to

be measured more precisely and be more controlled have been loosely adapted in the form of a questionnaire in order to use overall percentages to ascertain the extent of experiencers' responses. This method will reveal whether or not each volunteer participant reports similar or dissimilar physical and emotional experiences as a result *of Imponderable Sound* and determine whether a particular infrasonic frequency can evoke an intended response within the sonic art environment. The results of the reports and questionnaires will be identified within this thesis, analysed and evaluated through critical reflective practice.

Reflective practice

Reflective Practice will enable me as a practitioner to think more deeply about the creative development of *Imponderable Sound* sonic art sculpture and its outcome. Pamela Burnard suggests 'Artists in particular give themselves over to virtually continuous reflective time, placing reflection at the heart of the creative process' (2006). Through the experience of reflective practice, new insights into the creation of *Imponderable Sound* installations can be gained and the effect infrasonic frequencies will have within the installation environment can be analysed to give mindful insight into the process of development. The self, as an artist and practitioner is important with regard to decisions that need to be made about the process and development. Reflective practice means being mindful of self

> ...either within or after the experience, as a window in which the practitioner can view and focus self within the context of a particular experience, in order to confront understand and move toward resolving contradiction between one's vision and practice. (Johns 2004 p3)

The idea of the *window* here is particularly poignant as an allegory of reflection and as Johns (ibid.) quotes from O'Donohue (1997)

> Many people remain trapped at the one window, looking out everyday at the same scene in the same way. Real growth is experienced when you draw back from that one window, turn and walk around the inner tower of the soul and see all the different windows that await your gaze. Through these different windows, you can see new vistas of possibility, presence and creativity. Complacency, habit and blindness often prevent you from feeling your life. So much depends on the frame of vision – the window from which we look. (O'Donahue 1997 pp.163-64 cited by Johns 2004).

Information from prior experiences and reflection upon experiences in new situations will create information that can be transformed into knowledge. Writers such as Van Manen (1990) believe that reflection takes place on a past action that is a reflection on something that has already taken place. Burnard (2006) however, insights that reflection happens in 'different time frames' and so a deeper distinction manifests. Argyris and Schon (1987, 1983) developed the idea of single and double loop learning, based on recognition and correction of a fault or error. Double loop learning modifies the 'error' by the introduction of new strategies and objectives to enable a new frame of reference and development, as the gaze through a new window or different perspective. Reflection-on-action and in-action allow for the reframing of problems that occur at a practical level. Schon draws attention to a distinction between reflection-on-action or after the event has taken place and reflection-in-action or whilst the event takes place. The development and progression of *Imponderable Sound* utilises both reflection-in-action and reflection-on-action. That is, whilst making

Prototype, reflection-in-action occurred. The way in which this informed *Imponderable Sound One Pipedream* (*IS1*) was a result of reflection-on-action, a reflection on the action that was the construction of prototype. Similarly, reflection-in-action occurred leading to changes into the design of *IS1*, *Imponderable Sound Two Venus* (*IS2*) and *Imponderable Sound Three Reflection (IS3*). Whilst the sonic and sculptural aesthetic of *Imponderable Sound* is composed and created respectively, it is reflection-in-action that initially guides the artistic process and development of the art object. Reflection-on-action occurs when *Imponderable Sound* is installed within the public domain and the experiencers' reports are analysed and triangulated with Angliss and Hope and scientific reports. Therefore *after* the creative process has taken place, the further reflection about the installation environment becomes reflection-on-action.

Haseman in his essay 'Rupture and Recognition; identifying the performative research paradigm (Barrett, E & Bolt, 2010) states that the methods and tools employed by the practitioner should stand as research methods in themselves and whilst he recognises that qualitative and quantitative methods are employed subject to the practitioner, performative research can be expressed as 'non numeric data, but in forms of symbolic data other than words in discursive texts. These include material forms of practice, of still and moving images, of music and sound, of live action and digital code.' Saying that, this research also employs mixed methods of qualitative and quantitative research but this is only an adaptation for practice as research as a whole.

Critical reflection into the sonic art practice of the development of *Imponderable Sound* installations allows me as a researcher to gain an insight into the effects of infrasound and to validate *Imponderable Sound.* By comparison of the art and intentions of two main artists that have incorporated infrasound within the sonic art environment (Hope and Angliss), and how they constructed and performed their work, and any observations they have commented upon after the work has been exhibited. An investigation into scientific reports into the effects of environmental infrasound or clinical findings will also be compared, and then finally the experiencers' reports of *Imponderable Sound One, Two and Three* will be analysed. In this way, three points of reference are considered for the conclusion.

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CHAPTER 3

3 LITERATURE REVIEW

3.1 The sensory experience

In this age of immersive and virtual worlds it has become increasingly apparent that the importance of audience experience is paramount, especially in the world of gaming and computing. However, the immersive has had its place in the gallery setting for some years. Examples of these works include *Poeme Electronique* composed by Varese and *Concret PH* by Xenakis composed purposely for a specific site, the Philips Pavilion in 1958 and designed to entirely immerse the audience within the space. The art object contained within a space, the space itself and the sensory experience of the audience thus offers more than just a singular experience - the sum of parts plus the experience becomes the art object (Mitchell 2010. Cited in Henriques 2011). The experience as a whole becomes not just about the aesthetic of an object, but has the 'ability to become, rather than merely represent' (Onorato 1997 Cited in Henriques 2011).

In the gallery space, artworks have claimed to immerse the audience by use of devices such as speaker placement, projections, TV screens and objects themselves to give a holistic experience. However sensory these artworks claim to be one sense, that of 'touch' is almost always omitted and through haptic perception this way of sensing can be introduced into the installation environment.

The term haptic perception relates to *'...touching objects and perceiving environment...by the hand and inner sensory experiences of the body to receive*

information through movement and perceiving the environment...' (Latinen, 2008 p31). Movement, such as the movement of air particles by sound, or the movement of an individual through an environment, generates a sensory experience on the skin and in the entire body (Revesz, 1950). By the individual experience of the space, by way of haptics, the environment is emphasised and understood through touch and sensory information is passed on from environment to individual.

Evelyn Glennie, the profoundly deaf international percussionist, states that through the sense of touch she herself interprets sound vibration which she senses through the air. In this way, Glennie perceives her environment through haptic perception and although she does not use the term, her explanation of how she hears sound implies this.

> Hearing is basically a specialized form of touch. Sound is simply vibrating air which the ear picks up and converts to electrical signals, which are then interpreted by the brain. The sense of hearing is not the only sense that can do this, touch can do this too. (Glennie, 1993)

She states that most human beings 'hear' sound in this way, however most of us who can rely on the use of the ears and it's mechanism for picking up sound, largely ignore sound detectable by other senses. Schneck (2005) offers a biological explanation of how sound can be perceived in this way and how the human body reacts to its environment. He says that by the physical stimulation of the body's sensory receptors, the information-processing networks within the body can relay this information to the brain by way of the neurological motor

functions of the body. Movement and perception of the environment via the hands and body leads to inner sensory experiences (Lahtinen 2008) which leads to an awareness known as ‘haptic perception’ (Hatwell 2003).

Haptic perception by the deaf is equivalent to the way sound is heard by hearing people, a process that has been observed and reported by neurologists using Magnetic Resonance Imaging (MRI) scanners. Shibata (2001) a neurologist, reports that deaf people process sound in the auditory cortex in the same way that people who hear through the ears do and from this it can be inferred that in order to make sense of music or sound the ears are not necessarily needed. *Imponderable Sound* incorporates vibration that is felt through the body and skin via the sense of touch. This enables the audience to feel and appreciate sound vibration by way of haptic perception. With the creation of a sculpture that emits infrasonic vibration within the installation environment, the sonic space is felt externally and internally as a charged atmosphere that ‘hugs’. Information is then passed from the sonic art environment directly to and through the physical body of the immersed audience.

3.2 Vibration connects

With his research into cymatics, Hans Jenny (1967) described how sound and matter connects through vibration and has shown how matter manifests into a variety of shapes and forms, dependant on the physical properties of the matter and the sound frequency utilised. His experiments involved direct application of sound to matter. It is this principle of vibration or sound frequency and how it can ultimately affect matter that is applied to the sonic art environment.

Imponderable Sound has the intention of charging the atmosphere and eliciting haptic perception in the experiencer. Julian Henriques in his book entitled Sonic Bodies (2011) refers to the visceral experience of what he terms 'sonic dominance' in reference to the reggae sound system and states that 'trouser legs flap to the baseline and internal organs resonate to the finely tuned frequencies, as the vibrations of music excite every cell in your body.' He refers to this as 'sounding,' which he describes as the kinetic movement on the corporeal, or more simply the movement or motion of sound waves or sonic frequencies on the physical body.

The most stimulating sonic frequencies that can be felt on the body are found in the bass frequency range, particularly those frequencies that lie in the lower spectrum of sound known as infrasonic frequencies or infrasound. Infrasound refers to sound waves that operate below the audibility range of the human ear (Oxford online dictionary 2010). The hearing spectrum of a human being is between 20 Hertz (Hz) and 20,000 Hz (Everest 2000), thus infrasound is that which operates below the hearing spectrum at 20 Hz. As a point of reference for how low this frequency is, concert pitch 'A' resonates at 440 Hz (Yost 1994).

Infrasound or infrasonic waves occur within a variety of atmospheric occurrences such as wind and thunder (Beddard 2000). In nature infrasound is generated by earthquakes, waterfalls, ocean waves and volcanoes, with renowned effect. When Krakatoa erupted in 1883, it was 10,000 times more powerful than the Hiroshima bomb (Guinness 2008) and windows were broken up to a hundred miles away with the infrasonic wave (Cody 1997). In the animal kingdom animals produce infrasound to ward off predators (Collin, Marshall

2003) and birds are said to navigate by using the earth's own infrasound to migrate and find their way home. Infrasound has been created by human beings through the manufacture of machines; jet engines for example, produce a sonic boom effect as they fly by that incorporates infrasound. In his book 'Sonic Warfare' Goodman (2010) reports how jet planes were used purposely to disorientate Israeli residents during the Gaza war in 2008/9. This is an extreme use of infrasound used only to harm in war and it should be made clear that it is most certainly not the intention for this research! Within the development of *Imponderable Sound* sonic art installations infrasonic frequencies have been used in order to bypass the ears and use the receptors in the body to induce haptic perception within the sonic art environment and are used in a much more positive way.

Infrasonic frequencies have been and are used in some of the holistic and therapeutic disciplines, for example vibro therapy, which claims to relax and to heal and, although not scientifically proven, overall the frequencies have a much more positive effect on the corporeal. It is this positive effect that is explored within *Imponderable Sound*.

Very little has been written about the effects that infrasound could have on the corporeal within the sonic art installation environment, although there are a number of artists who have incorporated infrasound as part of the work. Carsten Nicolai used milk as matter in his installation 'Milch' (2000). He subjected the milk to sine wave frequencies of between 10Hz – 150Hz much in the same way as Jenny did in his 'cymatics' research. The direct correlation between sound signals becomes visually apparent in Nicolai's work when the milk reacts and

forms patterns on the surface. Nicolai's concept in this instance was the relationship between order and disorder within art whereas Jenny explored the relationship between sound and matter from a scientific perspective.

Matt Heckert created an installation entitled *Resonator* (1999), which was installed for the Festival of Eyes and Ears in Germany. The installation created a sound environment that physically interacted with the audience by discharge of low frequency vibration. The installation itself was a pipe that was the height of an average human being with a 'T' shape above. The 'T' of the pipe had a huge diaphragm at either end and was mechanically pulsed (Davies 1999). The pulsation created would move air in the sound environment and subsequently interact with the audience.

3.3 Effects of Infrasound

Pellegrino, a scientist, suggests that infrasound in general has a negative and intrusive effect on the body and states...

> Acoustic intrusions reduce your freedom of thought. There is no escaping sound. It meets your body and forcibly enters your mind, not just through your ears but also via your bones, your flesh, and your body cavities. (Pellegrino 1997)

Although the above quote is pessimistic, it is in reference to those who live within close proximity to wind turbines. It has been scientifically proven that the turbines emit infrasound and those unfortunate enough to live close by have reported ill health as a direct result of wind farms. The residents are subjected to the infrasonic drone twenty four hours a day, seven days a week and have no

choice in the subjection of infrasonic effects. Although, *Imponderable Sound* delivers vibration through vibrotactition, it can be considered less intrusive because the audience choose to take part in the experience and are free to enter and exit at their leisure.

A great deal of relevant health and safety research has been published about Vibroacoustic disease (VAD), which is a 'whole-body pathology' that develops in individuals exposed to Infrasound and Low Frequency Vibration (ILFN). This has been identified within several professional groups employed in the aeronautical industry and in other heavy industries (Alves-Pereiraa, Castelo-Branco, 2007), all of which claim that infrasound has been linked to bodily changes and unusual experiences (Radford, 2003a). It is the bodily changes and unusual experiences that are remarkable here and are explored within *Imponderable Sound* installations, although not to the magnitude of a wind turbine or jet engine. What is noteworthy is the effect of infrasound on the body and how this is adapted for use within the sonic art installation environment. As *Imponderable Sound* invites the audience to enter and exit as they please, then duration and subjection becomes self-defined. Interestingly though, another scientific report explores the exposure to infrasound in terms of duration on human health stating that when male volunteers were exposed to infrasonic frequencies of between 5Hz and 10Hz for fifteen minutes, they began to feel emotions of fatigue, apathy, and depression. They felt pressure in their ears and experienced a loss of concentration, they felt a sense of drowsiness, and they could feel a vibration within their internal organs (Duck 2006). In contrast another study concluded that a human being can only be subjected to extreme vibration for up to four hours (Krajnak 2009).

In planning *Imponderable Sound* installations a maximum exposure limit of four hours and a minimum exposure of fifteen minutes for infrasonic frequencies take effect were considered. The scientific studies by Duck (2006), report on particular singular infrasonic frequencies that have been found to cause ill health and induce negative side effects. They are said to be frequencies between 5Hz and 10 Hz and this raised an interest in singular infrasonic frequency for the development of *Imponderable Sound*, along with questions of how the relationship of different frequencies can cause a different effect on the corporeal within the sonic art installation environment.

When Dr. Amanda Harry (2007) looked at the relationship between various infrasonic frequencies and how they affected the body, she noted that low frequency noise or infrasound, caused feelings of discomfort, head symptoms, chest and abdominal pains, and could influence speech delivery, even causing a need to urinate. She related these symptoms to particular or specific infrasonic frequencies. (See table 1).

Harrys infrasonic effects

Frequency HZ	Symptoms
4 – 9	General feelings of discomfort
13 – 20	Head symptoms
13 – 20	Influence on speech
12 – 16	Lump in throat
5– 7	Chest pains
4– 10	Abdominal pains
10– 18	Urge to urinate

Table 1

In the table above, it can be seen that the report suggests that infrasound induces quite negative physiological effects, such as general feelings of

discomfort from the lowest infrasonic frequency of 4-9 Hz to an influence on how speech is articulated in response to the higher range of 13 – 20 Hz. Harry's subjects lived in close proximity to wind turbines and were subjected to infrasound day and night as discussed earlier.

Skille and Alvin (1968) have defined more positive principles for vibroacoustic therapy, which stated that low frequency sound reduced tension and assisted relaxation (Wigam, Saperston, West 1995). This is in contrast to research by Harry and Dr. Tomatis, who developed a method to re-educate the way we listen (Bogdashina 2003) and suggested that low frequency sound drains the brain (Goldberg, Trivieri, Anderson, 2002). There are other more alternative therapies such as harmonic healing and subliminal relaxation that claim that frequencies can heal and stimulate the body to a more positive outcome, although none of these are scientifically proven.

Michael Triggs (2010) compiled an extensive list of the positive effects of infrasonic frequencies that ranged from 0.1 Hz to 1 petahertz[1] (PHz). His list suggests that specific frequencies can help against specific illnesses, although once again his list has not been scientifically proven. In the table below (see table 4), a brief cross section of a rather more extensive list of Triggs' compilation of frequencies that can allegedly 'heal' is revealed.

Triggs effects

Frequency (Hz)	State
0.28 – 2.15	Alcohol addiction
4.11	Associated with Kidneys
8	Learning new information
38	Endorphin Release

Table 2

[1] Petahertz is 1,000,000,000,000,000 Hz.

Table two shows that 0.21Hz – 2.15Hz can help alcohol addiction, 4.11Hz can help with kidney function and 38Hz can release endorphins in the brain, the extreme opposite of Harry's results revealed in table one.

David Walonick (1999) looked at the effect of electromagnetic waves on the brain; the difference between this and sound waves are that sound requires the air around it in order to move, compression and rarefaction, and electromagnetic waves can penetrate without the use of another medium such as gas or air. Electromagnetic waves can be used in space, however, sound cannot. Both waves are measured by using Hertz. Walonick used electromagnetic frequencies between 6Hz – 10Hz on brain waves and noted that the brain locked on, or followed and mirrored specific frequencies. If a 1Hz frequency is played to the brain it will oscillate in response at 1Hz. The brain very quickly locks on to specific frequencies, usually within a quarter of a second and Walonick stated that if 'lock-on' did not occur within the first second it usually did not occur at all. He stated that the brain locked on to the higher infrasonic range more easily than the lower end (below 8.6Hz), which demonstrates that the brain itself will respond to extremely low frequencies, and if this is so, by using electromagnetic waves then there could be a strong possibility that this would also be the case for use of a mechanical waveform such as sound.

Vic Tandy (1998) is a scientist who has conducted extensive research into the effects of 17Hz on the human body. Stirred by an apparition he witnessed in his laboratory, he set out to disprove what he had seen and found that a ceiling fan

in his lab emitted a 17Hz frequency. Interested in the synergy of 17Hz and apparitions, he then measured the frequency at alleged haunted sites in the UK and he found that there was always a resonant frequency of between 15-17Hz. He then concluded that there was no such thing as ghosts or apparitions and stated that people who have claimed to have experienced the paranormal are simply susceptible to that particular infrasonic frequency. Based on Tandy's research of haunted sites, artist Sarah Angliss conducted an experiment called 'Infrasonic; Soundless Music' and held two contemporary music concerts at the Purcell Rooms in London. She masked a 17Hz frequency alongside an electronics piece of music, 'She Goes Back under Water' (2003) and an acoustic piano. She registered the listeners' emotions before they entered the room and then at four different points throughout the performances, she concluded that there was no change in emotional response in the presence of infrasound; however, she did state that infrasound boosted a number of strange experiences among the audience, even among those who were unaware of its presence. Unusual reports included a sense of coldness, anxiety and shivers down the spine. Surprisingly, all the reported responses are ordinarily associated with seeing ghosts. Angliss masked the 17Hz Frequency with the sound of pianos and electronics, creating what is in fact a subliminal stimulus. In contrast, *Imponderable Sound* uses infrasound in its essence as the sound or non sound produced and is not masked or clouded by the addition of other instrumentation. Angliss states "It's exciting and daunting to be composing music when you can't predict its emotional effect". This is an interesting statement in relation to Triggs' list of specific infrasonic frequencies, which suggest certain frequencies do predict specific emotional effects. In relation to this, *imponderable Sound* explores the prediction of an emotional effect by

using a single frequency and adopts Triggs list in order to do this.

3.4 Artists and Infrasound

There are a few sonic artists who already use frequencies that resonate below the audible frequency spectrum, but these practitioners do so without an investigation into how and why it affects the human body in a particular way. ‘Live room’ (Bain 1998) was a site specific installation that used equipment that enhanced the movement of air through vibration, in direct relationship to the room, in an attempt to ‘tune in’ the location using resonant frequencies or vibration. Bain used machines to ‘fuse into architecture combining forces of action into form, structure and space’ (ibid). He used motorised transducers that were attached to the columns of an old warehouse to vibrate the building using beat frequencies. The structure of the building was so large that the sound that manifest was infrasound. Bain reported that;-

> *The Live Room* constructs a topological space composed of virtual objects which haptically interface with the audience. By interacting with the cycling wave forms the visitor is occupied, infested with frequencies, modulated by vibrational energy and imparted with the volumetric sensibilities inherent within the body. The audience are the activated objects, traversing the site and feeling the liveliness of themselves, others and the space within. (1998)

He explains that everything has a resonant frequency, human bodies and buildings alike and if this frequency is activated, it is possible to strike a material with a vibration akin to a bell being struck. He states that the infrasound that is created has been known to elicit strange physical phenomena in the visitor,

such as nausea, headaches, the gag reflex and the urge to defecate. Other occurrences are changes to the sense of orientation and balance and the vestibular system whereby a feeling of a shift in the horizontal vision may occur. This main aim for Bain was to have a 'live' room and explore the effect of the interaction between air, room and audience. *Imponderable Sound* draws greatly on a similar 'liveness' of the installation environment, however, it seeks to investigate specific effects in relation to specific frequencies.

'Ghost station' (2007) by Kristen Roos, was a sonic installation that was contained in a disused railway tunnel at Lower Bay Station and explores the vibration quality of the installation environment. The installation contained 'infrasound and tactile sound: where sound is felt rather than heard'. Roos states that the vibratory sound has been associated with the paranormal and ghostly sightings, which is a reference to the research of Vic Tandy, however he offers no other information in regard to any specific frequencies he may have used or indeed why he used it, and seems content with just the vibratory aspect of the installation. The vibratory element of infrasound is important within this research, however, *Imponderable Sound* offers further insights into the effects that a specific infrasonic frequency has on the corporeal within the sonic art environment.

Sonic artists Yau and Arford suggest that the installation piece 'Infrasound' (Arford, Yau, 2006) is not about music; it is about new ways to hear with the body. The body can be provoked and the sound perceived can trigger what he calls "autonomous psycho-physiological responses". The piece explores mainly the resonance or sympathetic vibration of sound and looks at how 'all things

work in one continuum'. In an interview with Kathleen Maloney (2005), Arford commented on the frequencies he used, 20Hz to 100Hz. He generated sine waves, which were slightly detuned, a difference of, in some cases, 0.1 Hz to create a beating pattern 'similar to the waving and shimmering sounds you hear when strumming notes on a guitar that are out of tune'. Arford and Yau's work used intense vibration, which resonated the space and created psycho-physiological responses in the audience. Although the piece is entitled 'infrasound', the frequency range that Arford revealed within the interview with Maloney was not in the infrasonic range. Infrasonic frequencies were, however, created by use of two sine waves with a differential of 1Hz, which is how the term infrasonic has been associated. What they actually created are in fact beat frequencies (Hume 2006). *Imponderable Sound* only uses one infrasonic frequency and therefore it does not cause a 'beating' effect.

'Interactive Infrasonic Environment' (IIE) (Gupfinger 2009) interrelates aural sound with tactile sound to create an experience for the whole body. The installation consisted of a 250-inch long organ pipe and a wind generator along with a video-tracking system. The audience could affect the sound within the space in order to optimise their comprehension of infrasound (Camponelli 2009). The other part of this installation explored how the interaction of the audience could change frequencies by way of a digital interface that changed the wind pressure through a horizontal organ pipe. The Gupfinger piece generated an auditory climate for the audience to experiment with the vibrations in the space going 'beyond the borders of human hearing and acoustic perception' This installation sought to re familiarise the audience with the perception of environmental or natural infrasound, and claimed that, we as

human beings are so bombarded in modern society with noise from other sources, that the natural ability to perceive sound through the body has been lost. The utilisation of a pipe is very close to the research and development of *Imponderable Sound*; however the aesthetic, and precise effect of one specific frequency, were not explored in 'IIE'.

Cat Hope (2010) is a composer who works predominantly with infrasound and in her art explores the interaction between the body and infrasonic frequencies. She has used up to 25 bass guitars to create infrasound in both performed works and installations 'Reduxis' (2010) was described as a 'very low Hz piece for 25 basses, performed in a locked gallery, the audience outside'. Lockwood (2009) reported on an earlier work of Hopes, in which she states that, she became entirely aware of sound waves running through her body, and noted 'the power of involuntary collaboration...' when the bass vibrates and suggests that 'the whole body hears'. Hope (2009) argues that, we need to listen to organised vibration in order to perceive it and distinguishes between hearing, listening and of sensing sound in other ways. She claims infrasound pushes the dimensions of silence, acousmatics and sound art even further with a combination of 'new ideas of how to listen' that incorporates the physiological possibilities of the listeners themselves. *Imponderable Sound* draws strong parallels with Hope's work in that it relies upon the physiology of the body to 'hear' within the installation environment. Hope, however, uses bass guitars and amplifiers within her performances, which are often placed underneath the seats in the auditorium and does not discuss the possibility of a haptic response to infrasound or. further to this, the intention to induce a specific response to the work in the way *Imponderable Sound* does - that is, by the incorporation of a

single specific infrasonic frequency intended to affect the audience in a designated way through the vibration of the corporeal.

3.5 Imponderable Sound Framework

Imponderable Sound aims to evoke a response and to create a different way for the audience to hear and perceive sound. Sound is felt by the body within the installation environment and an intended effect is created by means of vibrotactility.

It has been suggested that manmade objects, such as machinery or wind turbines produce infrasonic frequencies that cause negative effects, as opposed to some reports that infrasonic frequencies can heal and generate an incredibly positive effect; there is a divide between science and the other ‘less proven’ alternatives. *Imponderable Sound* hopes to generate, through installed sonic art, an overall positive effect.

Artists who already work with infrasound do so for very different reasons to *Imponderable Sound*, although there are some close parallels to artistic work that has preceded it. Arford and Yau aimed to connect sound and space and body and space, Gupfinger used a pure infrasound in isolation, but most sonic artists, such as Angliss and Hope, have used infrasound that has been masked with other music or sound. *Imponderable Sound* aims to create a multi sensory immersive experience within the sonic art installation environment.

CHAPTER 4

4. *Imponderable Sound* Sonic Art Installations

4.1 Introduction

Imponderable Sound is immersive and sensory sonic art sculpture designed for the installation environment that emits infrasonic frequencies that affect the corporeal both internally and externally. *Imponderable Sound* looks at sensation and the experience of sensation through haptic perception.

I will reveal and defend *Imponderable Sound* as the creative component to this practice as research project. I will offer a description of the three *IS* sonic art sculptures that were developed and exhibited as individual creative components, along with *Prototype* that preceded them. This evaluation adopts a process of enquiry by reflection-in-action and, after installation, reflection-on-action into the creative design of *Imponderable Sound.* It reveals how the material form of *Imponderable Sound* sonic art installations developed chronologically through practice as research and reflection and, as an art object became research output in relation to the aims of this project listed below;

- To construct sonic art installations, known as *Imponderable Sound,* that incorporate infrasonic vibrations
- To survey and analyse responses to Imponderable Sound
- To determine whether different infrasonic frequencies used in Imponderable *Sound* sonic art installations will result in different audience responses.

The *Imponderable Sound* installations are discussed in chronological order. After a brief description of the sculpture and installation, three main themes are discussed in relation to the production of *Imponderable Sound*. Firstly the artistic production of infrasound within *Imponderable Sound* sonic sculpture, secondly the aesthetics and space in relation to the installation environment and *Imponderable Sound* sonic art sculptures and lastly the reported results and discussion in relation to haptic perception of sound and how each revolution of the process has informed the next.

The results of self-devised questionnaires are discussed throughout the chronological development of *Imponderable Sound s*onic art sculptures in relation to aim two of this research project; to survey and analyse responses to *Imponderable Sound*. It compares and contrasts my own findings with those of Angliss, Harry, Skille Tandy and Triggs. The reported effects of *Imponderable Sound* will then reveal how infrasound has been perceived in the sonic art environment and will attempt to determine if one frequency differs in results to another. Four *Imponderable Sound* sculptures were created for this research project and named as follows;

1. *Prototype*
2. *Imponderable Sound One: Pipedream (IS1)*
3. *Imponderable Sound Two: Venus (IS2)*
4. *Imponderable Sound Three: Reflection (IS3)*

4.2 Prototype

4.2.1 Introduction to Prototype

The initial conception of *Imponderable Sound* was inspired by Tandy's research into 17Hz and ghostly apparitions. This led to questions in regard to how this could be achieved within sonic art. Angliss, in her research into the same 17Hz frequency, had written about her interest in organ pipes and how the largest pipe of the instrument emitted a very low infrasonic frequency intended as a form of godly control to an unsuspecting and uninformed congregation. Gupfinger also utilised a pipe in his installation 'Interactive Infasonic Environment' which imitated an organ pipe with a fan, but rather than vertical, the pipe was laid horizontally on the floor. The logical beginnings were to use a pipe to produce infrasound in a similar way, to test material qualities, size and timbre.

4.2.2 Prototype and Infrasound

Experimentation into the development of *Imponderable Sound* began with a hard plastic drain pipe approximately six feet in length with a diameter of approximately five centimetres (cm).

Initially, to find out the resonant frequency of the pipe it was struck. This action generated 120Hz which was measured using an iphone oscilloscope application. Two problems were highlighted by this action, the first was that the frequency was not in the desired frequency range and secondly, the sound had a sharp attack with no sustain. To rectify the latter, a small domestic fan was used to 'blow', as breath, at one end of the pipe, which drew from Gupfingers' piece IIE, and in itself generated a pianissimo drone with a smooth sine wave

timbre. By using the fan I found that it also had its own frequency of 50Hz. (Worked out by using a Blade Pass Frequency formula (BPF) BPF=n t /60. Where BPF equals Hz, n equals rotation velocity (rpm) and t equals the number of blades). The timbre of the drone of the fan had the necessary sonic qualities that I desired for the resonance of *Imponderable Sound*, however the frequency emitted still did not lie in the required infrasonic range and I summated that as a result both the fan and the pipe would need to be much larger.

4.2.3 Prototype, Sculptural component and space

Prototype informed the visuals, use of material, size and the decision to use a fan to resonate or excite the air as breath - as if blowing in to a giant flute. Drainage pipe is a found product so could be used as an inexpensive option for the creation of the sculptural element of *Imponderable Sound*. It came in various shapes and sizes, bent, straight, different lengths and diameters, different angles and joints along with a variety of materials such as plastic, metal, cardboard and even glass, and was durable as it was intended for industrial use. It was a way to 'sculpt' by putting together various pieces into a desired shape as you would Lego bricks.

These initial forays through practice informed the size of the next sculpture, which needed to be much larger in order to create a frequency within the infrasonic range and, as a result, I investigated extreme bass instruments such as the Japanese taiko drum, the Octobass (developed by Jean Baptiste Vuillaume (1798-1875)), Long String Instrument (developed by Ellen Fullman), and Hyperbass Flute (developed by Roberto Fabbriciani). I found that the

lowest note of a hyperbass flute was C0 or about 16Hz (Hogenhuis 2009), which lay in the desired frequency range. Also, the size and measurements of the hyperbass flute could be replicated using drainage pipe and sculpted into the desired shape. The frequency emitted by this size of instrument was close to the 17Hz frequency explored in Tandy's research of haunted sites and Sarah Angliss' experiment 'infrasonic soundless music'.

This early stage also generated thoughts in regard to what the sculpture would look like, how a drain pipe could be re appropriated and be visually transformed. Both Gupfingers 'IIE' pipe and organ pipes per se, have no intended sculptural aesthetic and are, what I considered to be function over form. It became important for *Imponderable Sound* to be functional in respect of emitting infrasound, but the form also needed to be considered.

4.3 Imponderable Sound One: Pipedream (IS1)

IS1 was installed as part of the Future Sound Festival, UCLan, Preston, in May 2012, at the EVA Conference, London, July 2012 and at Korova Arts Cafe & Bar. Preston 2014

Imponderable Sound One: Pipedream (Figure 1)

The above image (fig, 1) was taken at the Future Sound festival 2012. It was at this event that questionnaires were first offered to experiencers and the responses used for this research. *IS1* was exhibited in a black box space of approximately 12m x 8m, illuminated by ultra violet (UV) light and UV paint. The sculpture was invisibly suspended from the ceiling with transparent fishing wire and was 12 metres long and 160mm in diameter. The space was already full of

very low frequency vibration from a vending machine and fridge that were housed in the space. The machine and fridge emitted an electrical buzz that complemented and interacted with the sonics of the installation. The sculpture and the space housed four ultra violet strip lights or black lights that produced a purple hue around them and enhanced the bright green glow of the sculpture.

4.3.1 Imponderable Sound One: Pipedream and Infrasound

As a result of experimentation with *Prototype, IS1* was constructed from larger plastic drainage pipe in order to emit a much lower frequency and was based on the measurements of the hyperbass flute. The pipes were approximately three times larger than *Prototype* with each bend being 3 metres in length, and four being used in total, which gave an overall length of 12 metres with a 160mm diameter. The measurements were slightly larger than that of the hyperbass flute as the precise size of underground drainage pipe was unavailable.

IS1 used the mini fan (as in Prototype) to reverberate the new pipe, which produced a frequency of 100Hz, 20Hz below *Prototype* but still not in the infrasonic range. This was a problem as the first installation of *IS1* was looming and I did not have the time, the finances or the facility to invest in new pipes/ fan and rework it and, as a result, other ways round this problem had to be considered.

Based on Tandy's research of haunted sights and Angliss' silent sound, I wanted *IS1* to emit a 17Hz frequency. I used a computer programme called 'Soundforge' to digitally synthesise a 17Hz sine wave, which was then looped and played back through a Tannoy subwoofer with a frequency response of

15Hz. The decision to use a sine wave, rather than a triangular or square wave, meant play back was much smoother than the bumpy and jagged characteristics of the other sound waves. On playback, the volume of the sub woofer had to be at maximum level for it to move the air particles and the vibration to take effect which was a concern, due to the volatile nature of sub woofer speakers and equipment in general. When used at maximum volume for an unusual length of time I have found that the voice coil can become over heated which stops the speaker from working. However, as a result, the synthesised sine wave was more powerful and had a better vibratory effect than just the fan, which had now, become redundant to the production of infrasound for *IS1*, as it was not powerful enough to provoke a strong reverberation and could not be seen or heard unless the ear was placed directly at the opposite end of the pipe.

I was disappointed that I hadn't managed to reverberate the plastic pipe itself with the mini fan and decided that a much larger fan would be needed for further development - one that had more power or *breath* for future *Imponderable Sound*. The digital synthesis worked well, although I still wanted to activate a sculpture that would emit its' own sonic vibration at this point.

For installation purposes, the fan was still used and placed in one end of the pipe sculpture to give the impression that this was the cause of the vibration. In order to further this impression the sub woofer was hidden from view when exhibited. In retrospect this was an artistic attempt to keep hold of the initial idea of using a fan to reverberate the pipe and to disguise the fact that a digitally created sound had been utilised instead.

4.3.2 Imponderable Sound One: Pipedream, Sculptural component and Space

The sculptural aspect of the pipe was intended to be, what I considered, a representation of the dreamlike or hallucinatory, which was pertinent to the title and the supernatural notions associated with the 17Hz infrasonic frequency. The decision to suspend it from the ceiling added to this concept and allowed the experiencers the space to walk around and look at the sculpture from all angles, to be visually stimulated, whilst the sonic vibrations energised and aided an immersive and tactile environment.

The use of glow in the dark paint and UV lights served to keep the installation space in darkness, to accentuate the central sculpture but also to impede the sense of sight to allow tactile senses to become enhanced. The use of suspended pipe, UV paint and UV lights became key to the identity of the sculptural aesthetic of *Imponderable Sound*.

The minimalist nature of the digitally synthesised sound had similar characteristics to La Monte Young's 'dreamhouse'. Sonically *IS1* became a single synthesised drone that activated its surroundings and harmonised with the fridges already present within the space. The interaction and harmonisation within the installation space of *IS1* encouraged further development of ideas related to 'Live' space, as in Baines' 'Liveroom' covered in the literature review, for the development of *IS2*.

4.3.3 Imponderable Sound One: Pipedream and Perception

In order to find out how *Imponderable Sound* had affected the experiencers a self devised questionnaire was used (see appendix 1). The first half employed quantitative methods and the second gave qualitative insights. The results were categorised or coded into seven groups, these being mood, vibration, atmosphere, leave, physical changes, positive and negative comments. These initial seven categories were important in order to survey what the experiencers had reported about each installation and whether each installation had evoked similar or different responses.

The *mood* category attempted to establish whether or not the general mood of the experiencers was changed as a direct result of *IS* and to discover whether or not experiencers noted a very general emotional response or just a response in general.

The *vibration* category sought to ascertain whether or not experiencers felt vibration on their skin and/or on their body. This was important to determine whether the same individual felt both types of vibration, or one or the other. If experiencers that felt no vibrations on their body felt no vibration on the skin, then it could be determined that no sensation had occurred.

The experiencers were asked about the *atmosphere* within the installation to try to determine a difference between the installation room and the space outside. This also connects to the *leave* category attempting to discover whether or not

the infrasonic nature of *Imponderable Sound* was considered to be tolerable by the experiencers and whether or not they wanted to stay.

The *physical change* category sought to identify what physical changes, if any the experiencers had reported, such as an increase in heart rate, blurred vision, perspiration, as revealed in the research of Duck (2006) and Harry (2007) and discussed in the literature review.

Both the *one word* and the *comments* categories served to compare the experiencers' overall *positive and negative* responses to *Imponderable Sound* Installations. The responses would also serve as comparisons to the positive effects reported by Skille and Alvin (1968), Triggs (2010) and the more negative reports discussed by Duck (2006) and Harry (2007). These categories would survey whether identical responses were reported by different individual experiencers and serve to investigate whether *Imponderable Sound* could ultimately evoke the same responses in a range of experiencers, to offer insights into the lived experience of *Imponderable Sound* and to determine how the sensory experience had been perceived. All the findings have been amalgamated and placed into a table. (Please see appendix 3)

Findings for *IS1*

Mood

61% of the experiencers reported being in a good mood on entering *IS1*, 50% said their mood changed during the installation and 50% said their mood had changed on exit. This result only suggests a change in mood; it does not define the type of mood change and whether this is as a direct result of the installation.

Vibration

49% of experiencers reported to have felt vibrations on their skin, which was an encouraging number. For a more exact reading Galvanic skin response apparatus could have been used, which more would precisely reveal actual skin responses but, by requesting this, the experiencers may have been distracted from the art experience. The low result could be due to clothing worn, which would make the vibration less detectable on the body and skin, however, it does demonstrate that the vibrotactile element of *Imponderable Sound* as vibration had been detected to some degree.

Over 65% of experiencers reported to have felt vibration on their body, which indicates that vibration was much stronger on the body than the skin. When referring to vibrations felt on the body I am referring to the visceral or internal effect that sound vibration has. Skin vibration is much more subtle and can be felt as a sensation externally. The location of vibration on the body was not revealed in the responses given and not requested either. It was clear that the concept of *Imponderable Sound*, was that of feeling vibration through the body and skin in order to perceive the sonic environment.

Atmosphere

69% reported that they could detect an atmosphere within the installation space, which indicates that the environment*, Imponderable Sound* and the experience became one, became immersive.

Physiological

The experiencers were asked to report if they detected any physical changes in their bodies, with 54% reporting that they could. Although physical changes had occurred, no indication of what these changes were had been revealed. Angliss found that her participants reported ‘increased heart-rate’, ‘headache’, ‘tingling in neck and shoulders’, ‘nausea’, ‘sense of coldness’.

One Word

In this section of the questionnaire I gave the experiencers more freedom to indicate responses to *Imponderable Sound*. In the first section I asked for a one word response and in the second gave the opportunity for more detailed comments.

One word *IS1*

Disorientated Alive Intrigued Still Uncomfortable Paranoid Calm Unwell Change Disorientated Calm Aware Relaxed Industrial Odd Uncomfortable Enclosed Dense Compressed Relaxed / Curious Enhancement Anticipation Dizzy Interested.

Table 3

Table three shows that of those experiencers who gave one word comments the majority used words such as ‘calm’ relaxed’ and ‘intrigued’, however 11 used words such as ‘disorientated’, ‘uncomfortable and ‘paranoid. Even though *Imponderable Sound* was intended to be a positive art experience the overall negative responses could be associated with the 17Hz frequency and, although not the same words used in Angliss’ and Tandy’s reports, could be interpreted as words that could describe a paranormal experience along with other negative effects reported by scientists. *IS1* had caused an emotional and physiological response in the experiencers.

Comments *IS1*

1. Felt like I was in a factory with an engine on a distant floor.

2. Felt like the vibration had travelled over a large distance.

3. Vibrations in the head and body I entered with two others and they both felt strong vibration on their skin and they both felt a bit nauseous after leaving but I felt minimal vibrations and intrigued when I left. A minute later began to feel dizzy. Felt it more with eyes closed

4. Felt very uneasy. Vibrations seemed to get stronger and weaker very slowly Felt sick after 5 minutes.

5. Slightly shakey. Power of suggestion on reading front page.

6. Dizzy slightly now. Ears popped.

7. Relaxed muscles. Meditative enhancement. Felt like I could plunge into a dreamlike state. Despite feeling unwell I found the piece really interesting

8. At first the pipe seemed to flex violently and twist. This settled down after a couple of minutes. I then started to feel slightly nauseous and my head felt thick – similar to how I feel when a thunder storm is approaching.

9. It was fascinating. Ghostly and powerful. I think something happened on an atomic level.

10. I felt some subtle vibrations in my arms on exit. They didn't last long however.

11. Awake. Felt the affects more after an extended period of time.

12. The noise and vibrations made the room an uncomfortable place to be – gave me a headache. Ear pressure.

13. Head felt like it had been stuffed with cotton wool - kind of tired and headachy. Body feels a little shaky.

14. The room gives a feeling of being in an aeroplane. It particularly affected my head area. The general atmosphere of the room was very relaxed and I felt more mellow whilst I was in the room. Have been in twice, first time there was no effect second time felt slightly nauseous

15. I felt as though the vibrations enhanced my heartbeat thus in turn I felt my skin hair stand on end. It was as if my pulse rate was brought out of my body, into the installation space and I could hear it outside my body.

16. Moving around the space gave very noticeable changes of effect! The visual impression of the pipe was fascinating.

17. Like being stood next to a bus similar frequencies Defined resonances.

Table 4

The comments revealed in table six showed that overall there had been a physiological response to *IS1*, with the majority of experiencers responding by commenting upon how they felt vibrations on their 'body and skin' and that the vibrations 'enhanced the heartbeat'. Some reported physiological effects such as 'dizziness' 'nausea' and 'ears popping'. Comments such as 'feeling unwell' 'my head felt thick' and 'felt very uneasy' suggest again a negative response that that could be associated with the 17Hz frequency.

One experiencer reported on the 'power of suggestion on reading front page', which is reference to the explanation on the front page of the questionnaire (see Appendix 1) given for ethical and health and safety reasons. The end paragraph states 'Reports into the effects of low frequency sound differ in their conclusions. Exposure for short periods, for example 15 minutes, has been said to induce reduced tension and relaxation by some but fatigue, nausea or headaches by others' and the majority of experiencers used similar, if not the same, descriptive words in their comments.

This is reminiscent of my earlier forays into the effects of infrasound and the power of suggestion, whereby, at the beginning of a lecture, I had set up a subwoofer in the centre of a classroom. I informed the students about my research and said that throughout the lecture I would play an infrasonic frequency. At the end of the lecture I asked them how it made them feel. Some reported that they felt a little 'weird'; others said that they felt a little nauseous and others said that they did not notice anything. I then showed them that the subwoofer was not actually plugged in and informed them that no frequency had in fact been played!

Conclusion of findings for *IS1*

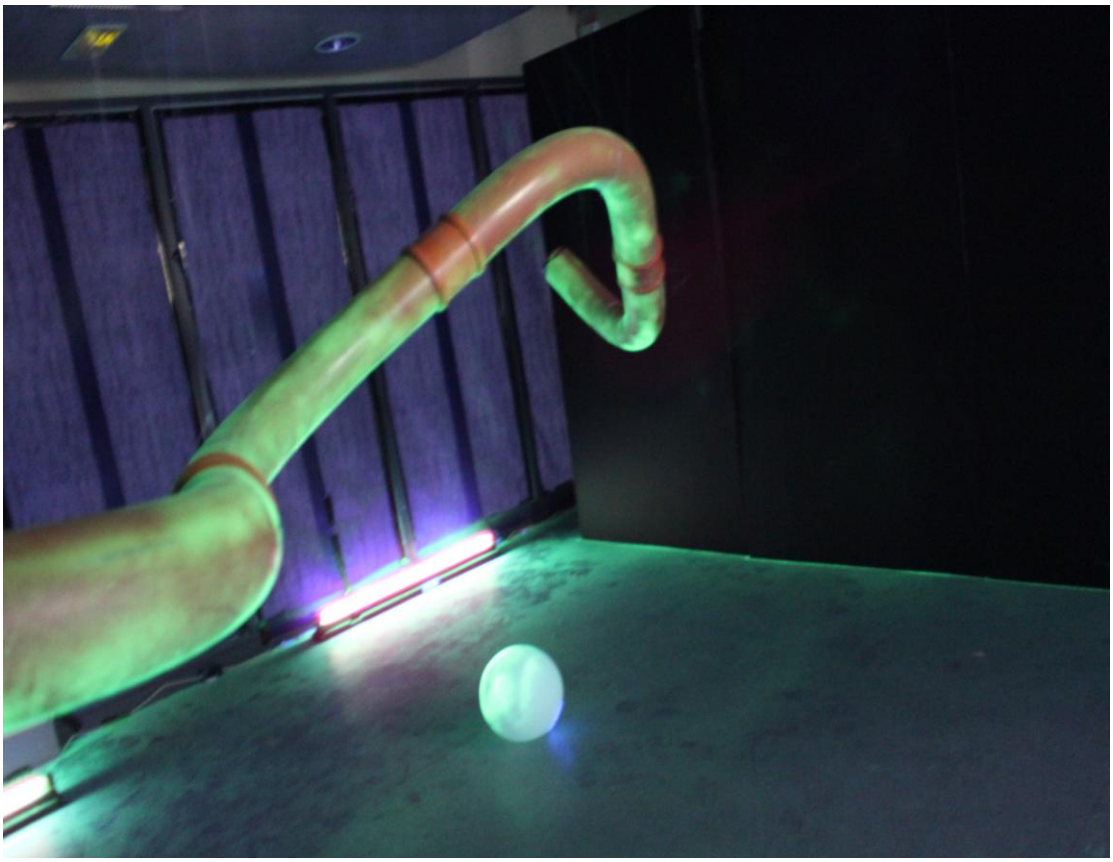
The production of a digitally synthesised frequency of 17Hz had been successful, although without the correct equipment to measure this in situ, it was not known if this was precise. The vibrations were powerful enough to interact with the environment of the installation space and connect to the corporeal and skin of the experiencers, and created the immersive and sensory installation environment I had intended.

The experiencers had reported emotional and physiological changes in their experience of the work. Some had reported that they could feel vibration on/in their body and on their skin. This suggests that they perceived sound through the mechano receptors of the skin and could suggest that they are more noticeably 'listening' through physiological sensation.

The one word answers and reported comments suggest that overall the experiencers had written words that can be perceived as negative; however one can take pleasure in being made uncomfortable, threatened or endangered. I observed the experiencers leaving the installation environment and the majority looked happy to have experienced it, akin to a fair ground ride. This negative response to *IS1* corresponds to scientific reports on the effects of infrasound and to the findings of Angliss and Tandy. I had used a 17Hz frequency in regard to the paranormal effect and postulated that the overall physiological and negative response was a result of this.

4.4 Imponderable Sound Two: Venus (IS2)

IS2 was installed as part of the Future Sound Festival, UCLan Preston in May 2012 and at the Transit of Venus Much Hoole Preston in June 2012.



Imponderable Sound two: Venus (fig. 2)

The image used above was taken at the Future Sound Festival and the responses given were used for this research. *IS2* was exhibited in a black box space of approximately 12m x 8m illuminated by UV light and UV paint. The sculpture was invisibly suspended from the ceiling and was 12 metres long and 160mm in diameter and included a sphere. The space was full of very low frequency vibration that resonated, complemented and interacted with its environment.

4.4.1 Imponderable Sound Two: Venus and Infrasound (IS2)

I had been commissioned by a composer called Julia Usher to work on a piece for mark the transit of Venus. She was herself inspired by my idea of *Imponderable Sound* Installations, and had already composed a piece entitled 'Venus', for woodwind. With her permission I digitally transposed a recording of 'Venus' down by six octaves and into the infrasonic range to play alongside the 17Hz frequency used in *IS1*. This was to further survey the experiencers' response to infrasound in sonic art installations and to survey if *IS2* would encourage a different response. This is similar to the way in which Angliss (2011) masked her piece 'She goes back in the water' referred to in the literature review. The transposed audio and the digitally synthesised 17Hz were played back in the space simultaneously through the same Tannoy speaker.

IS2 activated the space just as *IS1* had; however, the use of infrasonic composition was difficult to playback at the required volume. As a result the installation space felt dense and the sub woofer distorted when volume levels were increased. This resulted in lower volume levels and decreased clarity of the vibration as a result.

4.4.2 Imponderable Sound Two; Venus, Sculptural component and Space

The development, setting and sculptural element for *IS2* was almost identical in its makeup to that of *IS1*, with two differences, the first being the addition of Usher's composition and the second being the addition of a sphere to represent the planet Venus changing the visual content in compliance with the title.

In *IS2* the sculpture and title reflected one another in order for the experiencer to make sense of the overall concept. The visual aesthetic, title and installation space became equally as important as each other.

4.4.3 Perception and Results *IS2*

The same self-devised questionnaire was used for *IS2* as that of *IS1* (see page 59).

Findings for *IS2*

Mood

90% of the audience reported being in a good mood on entering the installations, 50% said their mood changed during the installation and 40% said their mood had changed on exit. This differed to *IS1* as only 61% had said that they were in a good mood, however with both *IS1* and *IS2* 50% of the experiencers reported their mood had changed.

Vibration

I found that the 40% of experiencers said that they felt vibrations on their skin..This was a lower proportion than *IS1* and I considered that this could be due to a more dense compositional texture.

60% of experiencers reported to have felt vibration on their body lower by 5% than for *IS1*. I considered that the lower reports were due to volume problems experienced with the recorded composition and limitations of the sub-woofer; however this was still a high percentage being more than half.

Atmosphere

A slight anomaly occurred here in that 90% of experiencers reported that they could detect an atmosphere in *IS2* as opposed to 69% in *IS1*. I considered that this was a result of the density of the composition and the addition of an extra sculptural component added to the atmosphere and meant that the experiencers were less attentive to the sound.

Physiological

The experencers were asked to report if they detected any physical changes in their bodies with only 30% saying they could, which is significantly lower than the 51% reported in *IS1*. This suggests that even though sound had been transposed into the bass range and could be considered as infrasound simply by its very pitch, it was not as effective as the single synthesised frequency used for *IS1*. *IS2* used Usher's piece which was originally composed for multiple instruments and it is possible that the timbre of the instruments did not transpose well. Also, the texture of the composition could have been too dense

for an effect to occur in that the composed lines of the melody and harmony negated it.

One Word *IS2*

Unsettled Serene Dizzy Intrigued Steady At Ease Relaxed Mysterious Great Alone

Table 5

Table five shows the limited one word answers given by experiencers of *IS2*. Overall, the experiencers used more positive words such as ‘serene’, ‘at ease’ and ‘relaxed’, different to that of *IS1* which gave an overall negative response.

Comments *IS2*

1. Crank it up a notch.
2. Super cool, loved it. Would like to holiday in there.
3. Seemed like more of a geographical experience at a cinema
4. Soothing, intriguing.
5. Listen down the DNA Stucture felt a constant flow of energy. Aesthetically pleasing (minus the buzz of the coca cola machine.
6. Interesting visual.
7. My general mood was at peace whilst subject to the sound.
8. Instaed of just standing there I would have liked a tiny adventure like making a planet move or something.
9. Exciting, innovative, brilliant.

Table 6

Overall the comments of the experiencers of *IS2* displayed a thoughtful response, with most people commenting on the visual aesthetic and what they wanted from the piece such as ‘ I would have liked a tiny adventure like making the planet move’ and instructional comments such as ‘crank it up a notch’.

Conclusion of Findings for *IS2*

The volume levels were low due to the overloaded subwoofer and recorded levels generally and due to this the vibrations were not felt as they were in *IS1* which I believe resulted in a more thoughtful pursuit of the experience.

Most comments however suggest a positive response to *IS2* as opposed to the negative responses that were revealed in *IS1*. I felt that with *IS2* I had created an immersive sonic environment that was effective and induced a thought process, however not as effective as *IS1* in terms of felt vibration. It was difficult to know where on the body and skin vibration was reported and whether or not this was an external sensation or an internal one, but the different aesthetic and sonic texture seemed to create an overall positive response.

As a direct result of the problems caused and the disappointing results attained, I decided not to use someone else's recording in future. However, in this case it was a requisite of the commission. I felt that, in the future, the sonic element of *Imponderable Sound* should either be the reverberation of the sculpture itself or a specifically digitally created drone as in *IS1*. *Imponderable Sound* should be my own infrasonic composition to be played back within the installation space or a synthesis of a specific frequency that lies within the infrasonic range chosen from Trigg's list of infrasonic effects.

4.5 Imponderable Sound Three: Reflection (IS3)

IS3 was installed as part of the Future Sound Festival, UCLan, Preston in May 2014

Imponderable Sound Three: Reflection (Fig. 3)

IS3 was installed in a dance studio with a wall of mirrors along one side. Similar features were used to that of *IS1* and *IS2*, the use of UV paint and UV light in a predominantly black space, sculptural pipe and infrasound as unique identifiable features of *Imponderable Sound* Sonic art installations. The sculpture itself was assembled from five six foot sections of vent pipe and four bends all at two and a half feet in diameter. On entering the installation the experiencers were asked to remove their shoes to protect the dance floor.

4.5.1 Imponderable Sound Three: Reflection and Infrasound

The sound design of *IS3* drew from the single frequency used in *IS1* and explored the original idea to reverberate a pipe with a fan to create a drone at a specific infrasonic frequency. *IS3* used a much larger pipe than *IS1* & *IS2,* in order to create a frequency in the infrasonic range, a more powerful fan to reverberate the pipe and used more flexible metal tubing, rather than the rigid plastic of *IS1* and *IS2*. However, early on in the development, the idea of using a fan was scrapped as the fan purchased was not powerful enough and financial concerns restricted investment into one more powerful to reverberate the giant metal tube. As a result a single frequency of 20Hz was synthesised different to the 17Hz frequency synthesised for *IS1* and *IS2*. A 20Hz frequency was on the border of the infrasonic range and chosen due to playback issues through the subwoofer (encountered in *IS2*) and, according to Triggs, it meant that this frequency would induce a meditative state that would energise and induce self-reflection. The effects of 20Hz in the installation environment could then be compared and contrasted to the reported responses of the 17Hz frequency used in *IS1* and *IS2* and would suggest whether different infrasonic frequencies result in different responses to adhere to aim three of this research.

The 20Hz frequency was played back inside the pipe through a subwoofer but was not powerful enough to create the vibratory effect experienced in *IS1* and to a lesser degree *IS2* and again was not loud enough in the larger space. As a result of this I placed an amp and a microphone in the opposite end of the sculpture to amplify the playback. This increased the volume to a desired level and also generated somewhat unexpected feedback. The outcome resulted in more elements than just the machine like quality of *IS1* and *IS2*. The use of the

amp and microphone were initially an attempt to amplify the volume of the 20 Hz frequency being but created much more musical depth, texture and interest than I had foreseen. The use of feedback created compositional elements of microtonal music and sweet spots provided subtle harmonies and melodies that had microtonal differences at different points in the room. The more subtle vibratory qualities of the work could be felt through the feet, enhanced by the wooden sprung floor of the dance studio.

4.5.2 Imponderable Sound Three: Reflection, Sculptural component and Space

This installation was intended to be much larger than *IS1* and *IS2* in order to emit a much lower frequency based on the principle that longer pipes produce lower frequencies. A mirror was important to reflect the size of the new sculptural pipe and also to encourage experiencers to see themselves and encourage self-reflection. *IS3* was ten times larger than the other two installations and used recycled aluminium vent pipe at two and a half foot diameter and five sections of five foot in length. The enormity of *IS3* was breathtaking on first entering the exhibition space and, as your senses adjusted, tingles of vibration were felt through the feet.

The visual of *IS3* was developed by the process and development of the findings from *IS1* and *IS2*. The sculpture was built on the principle that it had to be much larger than *IS1* and *IS2* in order to resonate at the desired infrasonic frequency. Aluminium pipes were used, rather than the rigid hard plastic of *IS1* and *IS2*.

The shape of the sculpture was designed prior to the acquisition of the pipes which meant sourcing the correct size and shape of pipe to replicate the design. Previous installations were simply suspended and designed after the purchase of the pipes and were a general representation of a dreamlike scenario to compliment the hallucinatory inference of the 17Hz frequency and the addition of a sphere as *mise en scene* explored in *IS2*. The pipe chosen was recycled vent pipe that can be seen in most offices, restaurants and businesses to convey heat or to purify the air. This gave me the opportunity to mould it into the pre designed shape and paint it to unify the look of *Imponderable Sound* sonic art sculptures.

Reflection was so called because of the 20Hz frequency chosen that could provoke a meditative state, energise and induce self-reflection as revealed by Michael Triggs (2010) and as a result specific environment elements were a requirement in terms of space. These were the use of a mirror, the sprung dance floor and a silent, unlit space. Similar features were used to that of *IS1* and *IS2*, such as the use of UV paint and UV light, a sculptural pipe and infrasound.

4.5.3 Imponderable Sound Three: Reflection and Perception

Amendments were made to the original questionnaire used for *IS1* & *IS2* (see appendix 1 & 2).

The original questionnaire contained information in regard to the effects of low frequency sound. I had noticed that the comments in regard to *IS1* had mirrored this so an additional sentence was added to the new questionnaire which stated

'…however, some people experience no effects and others experience effects that are different from those listed above'.

All questions changed in format, in that a choice of five words was offered to the participants rather than the original 7 point Likert scale. These words were; 'great', 'good', 'indifferent', 'bad', 'poor' and would eradicate semantic confusion when interpreting.

Questions now also asked for a YES/NO answer rather than a choice of numbers on the Likert scale and an additional question was added which asked 'If yes, describe…' in order for a more defined answer as explained below.

A further question was added which asked experiencers if they felt vibrations inside the body YES/NO. For those who answered YES a further question asked 'where inside did you feel the vibrations' and gave example places such as 'chest area' or 'abdomen' etc.

A question regarding severity of felt vibrations was also added and participants were again given a choice of five words to choose from which were; 'extremely', 'greatly', 'moderately', 'mildly', and 'hardly', again to determine the degree of vibrations.

Lastly there was the addition of a question that asked experiencers whether or not they felt that it was the installation *IS3* that had caused changes or more general reasons.

On the day that *IS3* was installed I was still awaiting ethical approval for the new changes to the questionnaire and as a result the original questionnaires were used and interviews were audio recorded. Although I was initially disappointed that the new questionnaires were not used, this became a benefit as it enabled me to compare the results with *IS1* and *IS2* in a more exact way.

Findings of *IS3*

Mood

I found that 56% of experiencers were in a good mood on entering the installation and 56% said their mood changed during, with 56% reporting that their mood had changed on exit.

Vibration

I found that 67% of experiencers said that they felt vibrations on their skin which indicated that detectable vibration had been significantly increased throughout the chronological development of *IS1* to *IS3*. There are several factors that suggest why this may be; the addition of the mic and amp increased the volume levels of the sound which in turn increased the vibration, the use of a different frequency, in this instance 20Hz which borders on the hearing range and perhaps more readily perceived and lastly, the installation space itself which consisted of a wooden sprung dance floor, wood being a natural amplifier in itself along with the suspended floor intensified the vibration.

Atmosphere

61% of experiencers reported to have felt vibration on their body and 61% reported that they could detect an atmosphere which was disappointingly lower

than *IS1* and *IS2* and suggests that this was a factor of the larger installation space.

Physiological

The experiencers were asked if they detected any physical changes in their bodies to which 44% reported that they could. Responses to *IS1* and *IS2* had been significantly higher and suggests that different room sizes, sculptures, and audio set ups can bring about different results.

One Word *IS3*

Happy	**Know**	**Harmonious**	**Engaged**	**Privileged**
Thoughtful		**Nice**	**Exhilarated**	**Calm**
Spaced/stoned				
Excited	**At-Ease**	**Intriguing**	**Good**	

Table 7

The one word answers given in table seven indicate an overall response to *IS3* which I considered to be emotional, with positive words used such as ‘happy’, ‘harmonious’ and ‘exhilarated’. Words such as ‘thoughtful’, ‘engaged and ‘intriguing’ suggests that experiencers were thinking about the art object and a cognitive response had taken place.

Comments IS3

1. It was an experience! Feels quite strange coming into a bright space again. The lights added to the effect.

2. It was very good. The fluorescent light made a difference, something quite exciting about it. Like you said before you made one step and it sounds completely different, because of the different speakers.

3. change, that was completely different. It reminds me of an installation she did when she was a student like you, she had sounds coming through several speakers and sat in chairs. You listened to it from one position and then another and it was different.

4. My mood, I have to say great after exiting. Quite spaced. I noticed from elation to headachy NOT anxious.

5. Spaced and tired. It’s a bit weird your ears are a bit funny!

6. Dark, Limbless. In contrast with the mirrors it made yourself look different. Because of the lights.

7. Majestic, awesome, beautiful, awe inspiring. Reminded me of a big snake, stone henge. Because of the mirror. The centre of it was like a worshipping place.

8. Felt the bowels of a machine. Being industrial and part of it. It felt like a passage to beyond, something quite spiritual or otherworldly like a UFO type thing.

9. I don't know. Quite tired, Not feeling happy. I felt a lot calmer when I came out. Gave a sense of being unreal, a sense of being in space.

10. If I'd have closed my eyes for very long the hum would have put me to sleep.

11. I think no. however the great feeling in terms of euphoric brought it down a little but not in a negative way.

12. Yes it did, but I didn't notice anything like oh god I'm not feeling quite as great now. I was a bit hysterical, you know laughing mood when I entered and excited. I really enjoyed it and felt like I didn't want to l;eave .

13. I thought that I may have a problem with it and it might get too much for me but it didn't at all.

14. Kind of, it was interesting I felt happier .More relaxed chilled out. I felt enjoyment and calmed a little bit. A more serene type of feeling It improved my mood. Chilled me out thought lots of things that I was thinking about. It changed something. Significant change in mood but heightened my attention span more.

15. Yes when you walk out it's almost as if it cuts off and your head spins a little bit. Everywhere you moved around the installation. Rhythmic sound to it Yes inside it made you feel very insular in a positive way. Very aware of breathing and swallowing. And your ears changed. Like going up a mountain in a car your ears popped. Oh yeah. Going in was different - a reverence for this sound and construction. Coming out was like coming through a air pocket.

16. Feels relaxing in places in other places irritating around my face, which is sensitive any way because of the condition I've got so it was very, soothing I'd say.

17. Fingertips and feet. Feet are directly on the floor where the floor is vibrating. I felt as though I'd had a slight massage. I felt a lot on my feet, back of my neck. Legs and arms.

18. Hair raising experience. I laid down on the floor and put myself into different positions and that's when I found the differences. So quite exciting really. Feet and back led down .Feet and on my bag sometimes. And when I touched the metal

19. Stomach, ears and through my head and my chest felt a little bit, well tightness start to build up in my chest. Towards the end of it.

20. I expected I would walk around then look at it. I wanted to go to different parts of it. General anesthetic. Like you are dying. Euphoric. Up into the holes in the sides, wanted to hum the note. Otherside sounded like the train track. At the front, hitting air pocket to another. Quite incredible. Like walking through a magnetic field.

21. Like ham slices. It was almost something I could feel. Rather than just hearing. Almost like a vacuum.

22. Excited by it all. I was in the centre I led on the floor , I felt as though life had stopped and I was living in a suspended moment. But using intellect.

Table 8

Responses in table eight indicate thought and assessment of *IS3* such as 'The fluorescent light made a difference' and 'a reverence for this sound and

construction', however, the majority of comments indicated cognitive thoughts about how the experience had affected them with phrases such as 'the centre of it was like a worshipping place', 'It felt like a passage to beyond, something quite spiritual or otherworldly like a UFO' and 'thoughts. Lots of things I was thinking about' pertaining to self-reflection in accordance to Triggs' (2010) list.

Experiencers also commented on where and how *IS3* was felt such as 'it's a bit weird, your ears are a bit funny', 'very aware of breathing and swallowing' and 'I felt as though I'd had a slight massage' and others such as 'felt like the bowels of a machine', 'general anaesthetic' and 'walking through a magnetic field' referred to an understanding similar to experiencing a machine. One particular response summed up the main intention of *Imponderable Sound* which was 'It was almost something I could feel rather than just hearing'. These responses suggest that *IS3,* once installed, provided stimuli that enhanced physical sensations around the body alongside contemplation in regard to the reading of the piece. The 20Hz frequency may have contributed to this response as, according to Triggs, is said to induce meditative thought.

CHAPTER 5

5.1 DISCUSSION OF *IS1*, *IS2* and *IS3*

A physical sensation in an immersive environment

A significant proportion of the experiencers said that they felt vibrations on their skin. *IS2* had the lowest proportion at 40%, this being Usher's transposed composition. *IS1,* using digitally synthesised infrasound at 17Hz, had 49%. This increased significantly to 67% with the 20Hz, added amplification and installation space of *IS3*. These figures strongly suggest that the infrasound of *Imponderable Sound* seems to have caused detectable vibration on the skin of the experiencers. This indicates how sound vibration and matter connect as described by Jenny (1967) in his research into cymatics, whereby he directly applied sound vibration to matter and observed the resultant shapes and forms.

Over 60% of participants felt vibration on their body (*IS1* 65%, *IS2* 60%, *IS3* 61%) which suggests that the installation space as a whole felt 'charged' and led to a space not only of sight and sound but to an immersive experience that creates a direct relationship between space artwork and body. Over 60% of the experiencers (*IS1* 69%, *IS2* 90%, *IS3* 61%) reported that they could detect an atmosphere, the anomaly being *IS2*, Usher's piece transposed, in which 90% reported that they could detect an atmosphere which suggests that a multi layered transposed composition as opposed to a single frequency (*IS1* and *IS3*), or the addition of an extra sculptural element such as the representational Venus, creates a more detectable atmosphere in the installation space.

Physical changes were reported by a large proportion of experiencers, *IS1* having the greatest percentage with 54% as opposed to 44% for *IS3*. This is

believed to be a result of the larger installation space and different audio set ups for *IS3*. The results for *IS2*, in which only 30% of the audience reported physical changes, suggest that sound that has been transposed into the bass range is not as effective for physical changes to be reported. The experiencers' reports did however, suggest that they became 'the activated objects' to which Bain (2003) refers, in that wave forms are transferred from the space to the experience and both connects. These subjective reports could be due to the phenomena of a new experience in which the vibratory aspects are more noticeable as a result of the experience.

Responses to different infrasonic frequencies

It could be suggested that by using different frequencies within *Imponderable Sound* different responses were highlighted, which correlates with Triggs (2010), Tandy (2008) and other scientific results. The responses to *IS1* showed that the 17Hz frequency induced feelings of paranoia, discomfort and disorientation, which is supported by how Tandy (1998, pg3 pp2) reported to have felt in his laboratory at the start of his research in which he said '*...he began to feel uncomfortable. He was sweating and cold and the feeling of depression was noticeable'.* The responses to *IS3* could suggest that the 20Hz frequency used induced reflective and meditative responses as words such as 'know' and 'thoughtful' and 'exhilarated were used in the questionnaire, which correlate to the list of infrasonic effects compiled by Triggs, however not conclusive. Harry (2007) reported some of the symptoms caused by different frequencies and said that 13Hz - 20Hz would cause 'head symptoms', 'influence on speech' and 'the urge to urinate'. However, this could be due to differences in experiencers', locations, differences in installation size, form and space. For

more conclusive evidence, the same sculptural element could be installed but with a different infrasonic frequency. The use of the same installation space would be more reliable to gain new insights. By using a different pipe and different installation environments each *Imponderable Sound* became individual and not the same. As a consequence, reported responses are difficult to compare. *IS1* used a 17Hz frequency and the experiencers reported an overall negative result using words that could quite easily lend themselves to a description of seeing ghosts. *IS2* used the same frequency but with the addition of a composition that was transposed into the Infrasonic range and overall reported a positive experience. *IS3* saw radical changes to the materials used, size, shape and made use of the 20Hz frequency resulting in an overall positive response that could be considered more contemplative.

Investigations into manmade objects such as machinery or wind turbines suggest that infrasonic frequencies cause negative effects to the individual. This is in contrast to reports by more alternative therapies that infrasonic frequencies can heal and generate an incredibly positive effect; there is a divide here between science and the other ‘less proven’ alternatives. The findings suggest that an overall positive effect to *Imponderable Sound* was found in line with less proven alternative therapies.

Over 50% (*IS1* 61%, *IS2* 90%, *IS*3 56%) of the experiencers were in a good mood on entering the installations, 50% (*IS1* 50%, *IS2* 50%, *IS3* 56%) said their mood changed during the installation and 50% (*IS1* 50%, *IS2* 40%, *IS3* 56%) said their mood had changed on exit apart from *IS2* which was Usher’s transposed composition. Whether this is directly due to the infrasound within the

installations I cannot be sure, however it is noteworthy that *IS1* and *IS3*, in which the sound was an intended single infrasonic frequency, instilled a mood change in the audience as opposed to *IS2* which was masked.

The overall positive reports from the comments given suggest that environment plays a large part in the positive experience of infrasound. Art installations and art and music, generally speaking, are pleasurable experiences as opposed to those experiences ordinarily associated with sterile laboratories or imposing wind farms, which have negative connotations and may induce negative responses to infrasound by association with location. Wind farms, erected in close proximity to residential homes, interrupt and interfere with everyday life as reported by Harry (2007) and result in long term unavoidable exposure. As an artist, I find the mechanical majesty of wind farms exhilarating, the 'dance' of the turbines movement just slightly out of phase with each other, giving the turbines individuality. I see beauty and innocence as the choreography never ends. I have sat at wind farms and absorbed the sound of the whirring, wind and the infrasound; an enlivening 'found' performance that excites me as an artist. Maybe the next *Imponderable Sound* could be site specific, simply giving place and time to the audience, letting the wind turbines perform in all their splendour. Would this idea then generate a negative response in line with scientific reports about wind farms?

The difference of *Imponderable Sound*

Artists who already work with infrasound do so for very different reasons to *Imponderable Sound*, although there are some close parallels to artistic work that has preceded it. Arford and Yau (2006) aimed to connect sound and space

and body and space and Gupfinger (2009) used pure infrasound in isolation. However, most sonic artists have used infrasound that has been masked with other music or sound, Angliss (2003) and Hope (2011) for example. The reports suggest that *Imponderable Sound* connects body and sound by using infrasound as a single frequency as Arford and Yau (2006), and Gupfinger (2009), and suggests that to perceive *Imponderable Sound* the body and skin can be employed in order to hear.

Infrasonic frequencies, synthesised digitally were incorporated into *Imponderable Sound* sonic art sculpture as a whole, although I could not measure the frequencies precisely, as I did not have seismological equipment. Although synthesised production can be believed to be true, playback through subwoofer speakers may not have the correct frequency response in order to do this. Initially, I wanted the sculpture to reverberate at its own resonant frequency, which would serve to render the playback issue nonexistent. Based on the principle that the longer the pipe the lower the sound, the resultant *IS3* sculpture became much more generously proportioned, but I was unable to reverberate the sculpture as intended, and so synthesised frequencies were digitally reproduced. I developed a synthesised sine wave frequency, that when amplified created a subtle vibration in the installation space, and the single drone transferred was transformed into a microtonal, harmonic and melodic composition, which created sweet spots and harmonies that changed dependent on where in the space you stood. In Gupfingers piece (IIE 2009), through movement and interaction with the space, his participants changed the sonics of the room, *IS3* emitted infrasound that remained in situ with micro tonal harmonics in different parts of the room, ‘waiting’ for the experiencer to discover

them. The sonic element created was of value to me as an artist and further research into acoustics may improve *IS* in the future.

Evaluation of the methodology used

Through practice as research and a mix of qualitative and quantitative research methods the chronological development of *Imponderable Sound* Sonic Art installations has been revealed and identified. In this research it was imperative for me as an artist to know what the experiencers reported to have felt emotionally and physiologically in order to understand how *Imponderable Sound* was viewed and understood. Without this information I felt the development could not progress. However, although it was interesting to reveal quantitative percentages of different effects that helped to measure the effectiveness of each installation, it did not reveal insights in the way that the interviews and comments did by implementing a qualitative method.

Research through art has revealed practical insights into the materials used for the sonic sculpture of *Imponderable Sound* and developed in relation to aim one of this research 'to construct sonic art installations incorporating infrasonic vibrations. It allowed for practical experimentation into the materials used, such as recycled pipes and the best material for this purpose. Technology such as the use of the computer programme 'Soundforge' for frequency synthesis was used along with playback speakers such as subwoofers. By using synthesised sound, frequency does not have to be measured by other unavailable equipment (such as a professional oscilloscope); however playback did create a problem with regards to the frequency response of the sub woofer speakers. Future practice-as-research could highlight more accurate ways to do this.

Practice through art highlights scientific reports into the effects of infrasound, along with other artists that have used infrasound in their work, such as Hope (2011), Angliss (2003) and Gupfinger (2009), along with my own findings that highlight the phenomena of the effects of infrasound on the corporeal within the sonic art environment. It has highlighted the relationship between the art object and how this has been physiologically, psychologically and emotionally sensed.

Experimentation with the same pipe as *IS3* but different infrasonic frequencies played back through the pipe would better determine a fairer response to the question regarding different infrasonic frequencies that induce different responses to different frequencies. Future experimentation could re shape the sculptural element of *IS3* to reflect new conceptual ideas that adhere to the effects of specific frequencies used. Future questionnaires could be more direct and specific if used at all.

There has been an intention to convey meaning through visuals and sound, for the visual to coexist with the sonic element. Without the sound the visual element and the title would work and serve as an interesting sculptural artwork, however with the addition of the infrasonic element, *Imponderable Sound* transfers into an immersive and sensory sonic art experience understood through the body.

The artefacts themselves, that is *IS1*, *IS2* and *IS3*, are the embodiment of thought, they are end products in themselves and by the employment of reflection in action, problems and errors have been rectified during the development process, along with reflection on action after exhibition. As an

artist, I wanted clarification from the experiencers about the relationship between my intention and their experience and perception of *Imponderable Sound.* By using qualitative and quantitative methods, responses have been surveyed and analysed in relation to aim two, ‘To survey and analyse responses to Imponderable Sound and to aim three’, ‘To determine whether different infrasonic frequencies used in Imponderable Sound installations will result in different audience responses’ has been determined.

In the future, along with practice as research, qualitative research methods would be used in the form of audio recorded interviews for example, to allow further investigation into the subjective ‘lived experience’ that would be underpinned by phenomenological philosophy.

5.2 CONCLUSION

This practice-as-research project produced sonic art installations that incorporated infrasound. The installations, known as *Imponderable Sound*, were used to survey and analyse responses in order to determine if different infrasonic frequencies would result in different audience responses within a sonic art environment.

Four *Imponderable Sound* sculptures were developed chronologically during the project and the effectiveness of the practical production of infrasound, the sculptural component and perception of the sonic experience was evaluated and readdressed throughout the process using reflective practice methods.

Infrasonic vibrations created a sensory and immersive environment in order to exploit the body and skin and to add another sensory experience, that of touch. To touch or feel the work by physical means, rather than just by sight and hearing, meant that the installation environment could be perceived haptically, not commonly explored in other sonic artworks.

Although *Imponderable Sound* had many parallels with other artists, such as Hope, Angliss and Gupfinger, major differences occurred in the sculptural component of the work along with the incorporation of individual infrasonic frequencies.

Scientific reports by Pellegrino, Harry and Duck found that specific infrasonic frequencies caused ill health and had negative side effects. Others, such as Skille and Alvin suggested more positive and therapeutic properties. These

preconceived effects of the frequencies determined the devising of the installations for the sonic art environment and defined what frequency should be used within each installation.

Imponderable Sound sonic art used 17Hz and 20Hz respectively when installed. Experiencers reported negative effects to the 17Hz frequency used in *IS1* and *IS2* using words such as ‘paranoid’ and ‘uncomfortable’. In *IS3,* where 20Hz was employed, words such as ‘happy’ and ‘harmonious’ were used*,* suggesting that each frequency brought about different responses showing further discrepancy between previously reported effects of different infrasonic frequencies. Overall a positive response was observed similar to that of experiencing a fair ground ride.

Imponderable Sound also caused detectable vibrations on the body and skin of the experiencer and some physical changes occurred. The denser the compositional texture in *IS2* meant the less likely vibration was detected. Low volume levels seemed to evoke more thoughtful ponderings about the experience in *IS3* and the sprung dance floor served to enhance vibrations felt.

Within each installation, especially *IS3,* I noticed a physical effect on the vocal chords. When attempting to speak the voice seemed restricted but also lubricated at the same time and appeared prominent in the installation space. Future *Imponderable Sound* could utilise this for a live performance setting and with the addition of the voice could further enhance the sonic element or encourage audience participation for interactive insights.

The difficulty in acoustically producing infrasound within my budget and time constraints meant that, to effectively reverberate a sculpture, digitally produced infrasound had to be used. This in turn created a problem with amplification as the sub-woofer speaker used proved to be prone to over-heating, especially with more complex low frequency sound, as with *IS2*, where louder volumes were necessary. Future development of *Imponderable Sound* could make use of other types of amplification such as bass amps (used to amplify bass guitars) or the thigpen rotary woofer (a huge industrial type fan placed inside a wooden wall) or a combination of multiple sub-woofer speakers for bass amplification. New ways of acoustic reverberation of the sculpture itself could also be developed.

Logistics, financial constraints and the lack of sizeable workshop space to house the sculptures impaired full experimentation and the development of such large sonic art sculptures. As a result, future development could look at ultrasound instead; a much smaller waveform that operates above the hearing range. By using touch or haptic perception, the sculpture could then be explored through touch to determine a shape without the use of vision.

Although each installation had its own positive strengths there were fewer definite conclusions to draw but a greater number of unproven inferences. The sonic space itself is felt externally and internally as a charged atmosphere that 'hugs'. Information is then passed from the sonic art environment directly to and through the physical body of the immersed experiencer. The senses of sight and hearing are engaged, along with an additional sense; that of touch, felt

through vibration and perceived by way of haptic perception as can be inferred from experiencer responses.

Equipment could be sourced, such as seismic vibration monitoring equipment, to measure the extent of vibration caused by the infrasound if at all.

A deeper understanding of the subjective experience of *Imponderable Sound* could be further investigated using phenomenological perspectives to gain advance insights into of the 'lived experience', which has not been addressed within this thesis.

Imponderable Sound has built on existing knowledge about the application of infrasound and haptic perception, as a means of perceiving this work. Previous practitioners have used sound that operates below the hearing range however; *Imponderable Sound* differs by using a single infrasonic frequency at a specific pitch. The investigation has been about how to create a sonic sculpture that emits a particular single infrasonic frequency that affects the experience, which has not been fully researched in sonic art before. The resultant reported effects changed throughout the process for, what I consider to be, the betterment of sonic art and can be built upon in future investigations.

Imponderable Sound caused detectable vibrations on the body and skin of the experiencer and some physical changes occurred. Within each installation I noticed a physical effect on the vocal chords. When attempting to speak or sing the voice seemed restricted but also lubricated at the same time and appeared prominent in the installation space.

Future research could use the vibratory and physical effects of *Imponderable Sound* to affect the performer and to investigate whether or not low frequency sound affects the nuances of playing an instrument with infrasound or whether, when singing for example, the delivery of the voice would have to be changed. Would this then cause the creation of necessary extended vocal techniques derived from the restrictions of the voice caused by infrasound, or a new way of playing an instrument based on a similar principle? This principle could also be used within contemporary dance. By using infrasound as an intervention a new approach to the development and performance of sonic art could be investigated.

I also plan to exhibit *Imponderable Sound Three: Reflection* in spaces around the country, aiming for the more prestigious galleries. This would enable further analysis of experiencers' responses to specific frequencies in connection with this research.

Imponderable Sound is art that is not directed at, or perceived by just one or two senses, but envelops the whole for an immersive experience. So, ponder the imponderable and be touched by the sound, so profound, *Imponderable Sound*.

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APPENDICES

Appendix 1

Questionnaire

Imponderable Sound One: Pipedream

This installation is part of an on-going project into the use of low frequencies in installation art.
Reports into the effects of low frequency sound differ in their conclusions. Exposure for short periods, for example 15 minutes, has been said to induce reduced tension and relaxation by some but fatigue, nausea or headaches by others.
No payment will be given for participation in this research project.
Data provided in questionnaires and interviews will be de-identified so that your anonymity is maintained in its presentation.
You have the opportunity to ask the researcher questions.
I confirm that I have read and understood the above information and agree to take part in the study.

Signature:_____Date:_____
___

Imponderable Sound One:Pipedream

Hello, thank you for experiencing my installation, 'Pipedream'. Pipedream uses infrasonic frequencies or sound waves that cannot be heard, within its composition and aims to create a particular response in you the experiencer. This short questionnaire will try to establish how effective the installation has been. For the purpose of the research could you take just a couple of minutes to answer the questions ? Thank you.

What age are you?

18 – 25
26 -35
36-45
46-55
56-65
66 -75
76 & over

What is your gender?

Male Female

What was your mood before entering the room?

Good 1 2 3 4 5 6 7 Bad

Could you detect 'an atmosphere' within the room?

Yes 1 2 3 4 5 6 7 No

Did you feel vibrations against your body?

Yes 1 2 3 4 5 6 7 No

Did you feel vibrations against your skin?

Yes 1 2 3 4 5 6 7 No

Did you feel a need to leave the room at any point?

Yes 1 2 3 4 5 6 7 No

Did you experience any physical changes?

Yes 1 2 3 4 5 6 7 No

Did your original mood change over the duration of the piece?

Yes 1 2 3 4 5 6 7 No

Did your mood change on exiting the room?

Yes 1 2 3 4 5 6 7 No

Give one word that describes how you felt during the installation _____

Comments_____
_____
_____
_____
_____
_____

Thank you for participating. Please hand the completed form back to the artist and she will reveal to you how she intended you to feel.
Results will be posted on my website www.myspace.com/theimponderablebomb and I can be contacted via email at JFlynn@uclan.ac.uk.
If you would like more information please leave your email address_____

Thank you
Justine Flynn

Appendix 2

Questionnaire

Imponderable Sound Three: Reflection

This installation is part of an on-going project into the use of low frequencies in installation art.

Reports into the effects of low frequency sound differ in their conclusions. Exposure for short periods, for example 15 minutes, has been said to induce reduced tension and relaxation by some but fatigue, nausea or headaches by others, however, some people experience no effects and others experience effects that are different from those listed above.

The researcher has requested that you experience the installation for 15 minutes; however you are free to leave at any point.

No payment will be given for participation in this research project.

Data provided in questionnaires and interviews will be de-identified so that your anonymity is maintained in its presentation.

You have the opportunity to ask the researcher questions.

I confirm that I have read and understood the above information and agree to take part in the study.

Signature:_____Date:_____

___

Email:_____(optional)

Imponderable Sound Three: Reflection

Hello, thank you for experiencing my installation, 'Reflection'. Reflection uses infrasonic frequencies or sound waves that cannot be heard, within its composition and aims to create a particular response in you the experiencer. This short questionnaire will try to establish how effective the installation has been. For the purpose of the research could you take just a couple of minutes to answer the questions? Thank you, Justine.

Questionnaire

1. What age are you?_____
2. Are you male or female?_____
3. What was your overall impression of the way the 'Imponderable Sound Three; Reflection' looked?
   _____
   _
   _____
   _____
   _____
   _____
4. What was your mood before entering the installation? Choose between; GREAT, GOOD, INDIFFERENT, BAD, POOR._____
5. Did your mood change during the installation? Yes/No_____
6. If YES, describe how it changed_____
7. What was your mood after exiting the installation? Choose between; GREAT, GOOD, INDIFFERENT, BAD, POOR._____
8. Would you say that the installation induced any change in your mood? Yes/No_____
9. If YES, describe how it changed_____
   _____
   _____
10. Did you detect a difference between the atmosphere inside and outside the installation?

Yes/no_____
_____

11. If YES, describe the difference/s detected_____

12. When you experienced the installation, did you feel vibrations against your skin?
    Yes/No_____
    _____

13. If YES, say where on the skin you felt the vibrations. For example forehead or fingertips
    etc._____
    _____

14. When you experienced the installation, did you feel vibrations inside your body?
    Yes/No___

15. If YES, say where inside the body you felt the vibrations. For example in the chest area or abdomen
    etc._____
    __

16. Did you experience any physical changes?
    Yes/No_____

17. If YES, what physical changes did you experience? For example increased heart rate or sweats
    etc._____
    _

18. How severe were the physical change/s? Choose between EXTREMELY, GREATLY, MODERATELY, MILDLY, HARDLY._____

19. How likely is it that these physical changes were as a result of experiencing 'Imponderable Sound Three; Reflection'?_____

20. Did you feel a need to leave the room at any point?
    Yes/No?_____

21. If YES, indicate how long you stayed in the installation space._____

22. Give one word that describes how you felt during the installation._____

23. Give one word that describes how you felt once you left the installation._____

    General Comments about 'Imponderable Sound Three; Refection'_____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____

    Thank you for participating. Please put the completed form in the box provided. The results will be posted on my website www.imponderable-sound.co.uk

    Justine Flynn

Appendix 3

	PIPEDREAM	VENUS	REFLECTION
		Mood	
Good	61%	90%	56%
Bad	30%	10%	11%
Change Yes	50%	50%	56%
Change No	30%	50%	39%
Exit Yes	50%	40%	56%
Exit No	26%	60%	28%
		Vibration	
Skin Yes	49%	40%	67%
Skin No	30%	60%	22%
Body Yes	65%	60%	61%
Body No	4%	20%	28%
		Atmosphere	
Yes	69%	90%	61%
No	19%	10%	11%
		Leave the Room	
Yes	38%	10%	22%
No	53%	90%	78%
		Physical Changes	
Yes	54%	30%	44%
No	27%	70%	39%

Appendix 4

One word answers

PIPEDREAM		VENUS	REFLECTION
		One Word	
Positive	Alive	Great	Happy
	Still	Mysterious	Know
	Calm x2	Intrigued	Harmonious
	Relaxed	Relaxed	Engaged
	Enhancement	Serene	Privileged
	Intrigued	Steady	Thoughtful
	Curious	At-Ease	Nice
	Interested		Exhilarated
			Calm
			Spaced/stoned
			Excited
			At-Ease
			Intriguing
			Good
Negative Uncomfortable x2		Unsettled	Relieved
	Paranoid	Dizzy	Unhappy
	Unwell	Alone	Dizzy
	Enclosed		Strange
	Odd		
	Dizzy		
	Compressed		
	Anticipation		
	Dense		
	Disorientated x2		
Anomaly Industrial			