Involuntary Musical Imagery, as conditioned by everyday music listening

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Abstract

Music in one's head is a very prevalent phenomenon in everyday life, but the aetiology behind it is still unclear. This thesis aimed to investigate the phenomenon of involuntary musical imagery (INMI), and particularly, under the hypothesis that it is a conditioned response from everyday music listening. Music listening can be a highly rewarding experience, and people use it more than ever to accompany their everyday lives: such systematic habits can create a process similar to classical conditioning, where, when two stimuli systematically pair, one will evoke the response that is usually elicited by the other. This premise has been investigated in three studies, designed specifically for this hypothesis: two laboratory-based behavioural experiments and an Experience Sampling (ES) study. The first experiment explored whether the conditioning process could be recreated in a laboratory context, by repeatedly pairing music with an activity. The second experiment explored the already established conditioning by investigating whether INMI would occur in the place of music: a stress induction experiment was designed to assess if individuals who use music to regulate their stress would experience INMI, in the place of music, as a coping mechanism. The third study explored INMI's relationship to music listening in the everyday lives of individuals in order to assess this premise in a real-life setting. Overall, the findings of this research were encouraging to the hypothesis, suggesting that there is a relationship between uses of music and INMI in the aspects of activities, mood regulation, genre, and valence, and some evidence that INMI can indeed be a conditioned response. While there were no strong findings that INMI can act in the place of music, the findings indicated that INMI had similar functions.

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1 Introduction

Music is a great part of the western, modern way of life (Cook, 2000); one hears music in the street, at home, in movies or on the television (Lonsdale & North, 2011; North, Hargreaves, & Hargreaves, 2004) to name a few occasions where music is heard by either the choice of the listener, or without their control. In addition to the music that is heard, people often find music playing inside one's head, with or without their volition or control, having thus similar attributes and circumstances, in terms of volition or control, with its external counterpart (that is music heard as opposed to imagined).

Musical imagery is the phenomenon of imagining music without external output of sound. The act of imagining music is very common, and it has two branches: the voluntary recall and the involuntary. The voluntary action is happening when, for example, one is thinking of or remembering a melody or a musical piece, or even manipulating the music, as it happens in musical composition. The involuntary experience is occurring when one experiences hearing music inside one's head without external output or conscious recollection of it (Bailes, 2007; Bishop, Wright, & Karageorghis, 2014; Cohen, 2009; Liikkanen, 2008, 2009, 2011; Williamson et al., 2011).

This thesis explores this aspect of music, that is playing inside one's head, without any conscious recollection, henceforth referred to as 'involuntary musical imagery'. Involuntary musical imagery is described as the experience of having music in one's mind, which comes unbidden, and is abbreviated as INMI (Liikkanen, 2008; Williamson et al., 2011).

The hypothesis of this thesis follows prior work by Filippidi and Timmers (2017). With the aid of a combined study of a questionnaire and a diary, we investigated whether music listening behaviours can relate to and/or form the musical imagery experiences of individuals. The proposed hypothesis of that study was that music listening influences the musical imagery experience, through a process of conditioning: with higher musical engagement in their everyday life, one has the potential of more (positive) associations with music, and therefore INMI could and/or would occur because of all these possible associations. In the case of limited engagement, one has less occasions where one puts music on to listen to, and therefore their interaction would be due to accidental exposure to music (possibly without their having control over the situation). However, dominance and control over the listening situation seems to affect the listening experience (Krause and North, 2017) and North et al.'s (2004) findings suggest that when their participants had not chosen to listen to the music that was playing, its rates of being annoying were considerably higher. As according to our theory, music listening shapes the INMI experiences, our prediction (Filippidi and Timmers, 2017) was that the INMI of the individuals with limited engagement would thus be mainly resulting out of recent exposure and would have an annoying hue.

The results of this study indicated that there is a relationship between the music listening of an individual and their musical imagery experiences. In particular, the activities and situations in which imagery was experienced had great accordance to the ones in which individuals were partaking when listening to music. Moreover, data showed that musical engagement correlated with the experience of musical imagery: annoying and repeating INMI episodes, that often resulted out of recent exposure, were mostly experienced by people reporting lower levels of musical engagement (listening and being involved with music). Moreover, the more engaged participants also reported INMI that was closer to their music listening tastes (in terms of genre) and it was perceived as more positive. This study was an initial exploration to assess whether music listening habits correlated with certain INMI experiences, and even though it was a correlational study, the results were promising.

The present thesis takes this hypothesis further and attempts to assess the conditioning relationship of music listening in everyday life, with musical imagery. The theory I am proposing is that involuntary musical imagery is the product (or more specifically the conditioned response) of the (unintentional) conditioning which takes place when music is systematically used in everyday life (more details follow in the next chapters). As this is a new theory, there were no prior studies establishing an experimental design precedent to follow (except for the aforementioned paper by Filippidi and Timmers, 2017) so the design of novel experiments aimed to address this hypothesis. This exploration entailed the design of two novel experiments attempting to replicate and observe this conditioning relationship in the lab, and the design of an observational, experience sampling study, which focused on both music listening and musical imagery experiences with the ultimate purpose being to assess whether the conditioning relationship is evident in everyday life.

1.1 Definition of INMI

The experience of having music in one's head is on many levels a complicated experience, and this is reflected in the literature of INMI, concerning the terminology of the phenomenon, its description, and its name; This has been, so far, a matter of discussion and discord amongst researchers (an overview of the different names and definitions is detailed in in Williams, 2015, Table 2, pp. 6–7). The phenomenon can be seen named as involuntary musical imagery abbreviated as INMI (Liikkanen, 2008), intrusive musical imagery abbreviated as IMI (Taylor et al., 2014), earworms (Williamson et al., 2011), tune on the brain (Bailes, 2007), spontaneous musical imagery (Wammes & Barušs, 2009), intrusive song (Hyman, Burland, Duskin, Cook, Roy, McGrath, et al., 2013), musical mind-pops (Kvavilashvili & Mandler, 2004), sticky music (Sacks, 2007), perpetual music track (Brown, 2006), musical obsessions (Taylor et al., 2014), and musical hallucinations (Vitorovic & Biller, 2013).

All the above are terms that seem to have a common ground of music playing inside one's head without the individual's deliberate recollection. However, the boundaries and specifications of these different terms are fluid and are often used interchangeably. Earworms are often described as intrusive and looping but the name has often been used interchangeably with INMI (Jakubowski, Finkel, Stewart, & Müllensiefen, 2016; Wammes & Barušs, 2009), while INMI has not been given such attributes by all researchers (Liikkanen, 2008, 2011). However, the experience of INMI is not always defined: some researchers suggest that INMI is the name for the fraction of music, stuck in one's head, which loops (Jakubowski, Farrugia, Halpern, Sankarpandi, & Stewart, 2015; Jakubowski, Finkel, et al., 2016; Williamson & Müllensiefen, 2012), and often the experience of INMI not looping is described instead as a 'mind-pop' (Elua, Laws, & Kvavilashvili, 2012; Kvavilashvili & Mandler, 2004; Williams, 2015). However, this classification is not always clear and is not widely embraced, as researchers investigate the experience of (non-pathological) having music in one's head as a whole (Bailes, 2015; Cotter & Silvia, 2017; Filippidi & Timmers, 2017; Hyman et al., 2013; Liikkanen, 2011).

Furthermore, the experience can take various forms, from being constant and persistent (Brown, 2006) to passing and fleeting (Cotter & Silvia, 2017; Schlagman, Schulz, & Kvavilashvili, 2006), and can be different for different groups (such as musicians or non-musicians, Bailes, 2007). The literature, however, seems to agree that some aspects of having music in one's head involuntarily, such as musical obsessions and musical hallucinations, have a clinical background (Colon-Rivera & Oldham, 2014; Güçlü, Şenormanci, Güçlü, & Konkan, 2013; Hermesh et al., 1994; Husain, Levin, Scott, & Fjeldstad, 2014; Stewart, von Kriegstein, Warren, & Griffiths, 2006; Taylor et al., 2014).

The knowledge regarding INMI has evolved greatly since the onset of the exploration of the phenomenon: only in the past decade has the INMI phenomenon started to be addressed in terms of research. The empirical exploration started by identifying the phenomenon and its prevalence (Bailes, 2007), then its commonness in the wider population (Liikkanen, 2008, 2009, 2011), and then by identifying the main categories in which it occurs (Williamson et al., 2011). While, so far, the research has tackled the identification and distinction of the phenomenon, the mechanism which is responsible for the occurrence of INMI still remains unknown. Some researchers have proposed a correlation with personality traits (Floridou & Müllensiefen, 2015; Floridou, Williamson, & Müllensiefen, 2012) or a possibility of it being a form of a mental failure (Beaman & Williams, 2010; Hyman et al., 2013). However, this could be a mere confound: that is, individuals with such trait and state characteristics happen to be experiencing INMI due to their accustomed music listening habits. Furthermore, INMI's resemblance to mind-pops and being reasonably classified as a form of involuntary autobiographical semantic memory (Kvavilashvili & Mandler, 2004) further confuses the situation.

Despite all the progress in understanding the phenomenon of INMI, the cognitive framework and the underlying reasons of why people have music in their heads remains unclear. This thesis puts forward the suggestion that this perplexity of names and definitions derives from this lack of knowledge, and suggests a new theory that offers explanations in the existing findings.

Kvavilashvili and Mandler (2004) proposed that involuntary musical memories may be occurring due to a long time priming with music listening. This thesis offers an extension on that theory, suggesting that the process that creates the INMI framework is similar to/based on the conditioning process. However, in INMI, unlike mind-pops (Elua et al., 2012; Kamiya, 2014; Kvavilashvili & Mandler, 2004), people often take pleasure and/or comfort in INMI and find further use for the music in their head, in order to keep them company, or to help them with what they were doing (Floridou, Williamson, Stewart, & Müllensiefen, 2015).

That could be because INMI is music, and music is often used in everyday life (Clarke, Dibben, & Pitts, 2010; DeNora, 2000; Levitin, 2007; North et al., 2004), and its presence in everyday life situations has been associated with the situations that it has been paired with (Baumgartner, 1992; Cady, Harris, & Knappenberger, 2007; Janata, 2009; Janata, Tomic, & Rakowski, 2007; Michels-Ratliff & Ennis, 2016; Platz, Kopiez, Hasselhorn, & Wolf, 2015). As individuals have specific tastes in music and repeat functions in music, which evolve and follow patterns throughout their lifetime, it is a valid question to ask to what extent this pairing can resemble a form of a conditioning process.

In the classical conditioning format, one (meaningful and/or response eliciting) stimulus is repeatedly presented (being paired) with another, until the latter acquires the response of the former. That is, when music, being a stimulus that is pleasant and as research suggests capable of dopamine release (Mas-Herrero, Marco-Pallarés, Urbano, Zatorre, & Rodríguez-Fornells, 2013; Menon & Levitin, 2005) and is also capable of arousing strong emotional experiences (Gabrielsson & Bradbury, 2011), is being systematically paired with an activity (as the music listening literature suggests it often does) from adolescence to adulthood on various levels and degrees, then the pairing would become involuntarily and unconsciously paired in a similar manner to that of the bell and the food in the famous experiment by Ivan Pavlov at the beginning of the 20th century (Pavlov, 1927). With the presentation of one stimulus, the other, having paired its properties with its newly established pair, will be created by the mind. Thus, the mind, having the two stimuli paired as one, will recreate the missing part on its own, thus restoring the whole. INMI is the conditioned response, in a conditioning process of music listening and its systematic pairing with everyday life, that being: activities, moods, situations, or any other functions that the music listening literature has revealed.

The aforementioned conditioning link, then, will be as complicated and individualised as the uses of music and the everyday life of its individuals. As each person has their own life-soundtrack, with certain links and associations, the conditioning process will vary accordingly. Therefore, the situations and the reasons for which an individual will experience INMI will vary accordingly. This explains the variation (and the lack thereof) in the top INMI hits, meaning that it is not comparable to one of the music top charts (Jakubowski, Finkel, et al., 2016) as seen in the Literature Review chapter of this thesis. Music listening reasons and functions vary within an individual, and one can use music as a mood regulation mechanism, but at the same time, also as a means of entertainment, and to accompany activities (North et al., 2004). As the above activities become regular, and they all take place, they all potentially create the links of conditioning which may have expressed themselves at any given time. This means that an individual may currently be performing an activity that they usually paired with music – like jogging – with which they usually listen to energetic pop music (DeNora, 2000), but at the same time, have been feeling ‘blue’, which was also a situation in which they would listen to sad music (Eerola et al., 2016). In this situation, since both conditioning links are active for this individual, and since the individual has engaged systematically in both, either one can emerge, depending on which feeling or activity is the predominant one.

This theory has been initially explored in a previous study (Filippidi & Timmers, 2017) in order to examine the degree to which the music listening habits of an individual relate to their INMI experiences. The findings of this study were encouraging: that there is indeed a link between the ways in which an individual engages with music, and these ways appear to be reflected in their INMI experiences.

1.2 Hypothesis

In this thesis, I aim to investigate the dependency of INMI from music listening, the link between them, along with the rationale of INMI under the scope of a conditioning process. In other words, I will be investigating the possibility of INMI being the product of involuntary conditioning that results from everyday music listening.

1.2.1 Research Questions and predictions

As mentioned above, this thesis presents the theory that INMI is the involuntary by-product of an unconscious conditioning relationship between everyday music listening and everyday life. As the premise of this hypothesis is a lifelong exposure to music, the method used to test for it was a series of testable predictions that have been created, which were tested through suitable empirical research methods.

The first is that music listening will define the circumstances in which an individual experiences INMI. In other words, the categories of the uses of music of an individual will be the categories for the occurrence of INMI. Individuals 'teach' themselves to receive information, which is music, in a certain and repeated way, and the association of music and the circumstances is unconsciously made. Thus, whenever the circumstances are recreated without the input of music, music will be generated by the mind itself, in the form of INMI. Therefore, individuals set up their own map of INMI experiences when they choose and practise their music listening habits. This would mean that if a person were using music as a mood manipulation tool, they would experience INMI when mood manipulation is needed. Accordingly, if a person were using music as a sleeping aid, then they would experience INMI while trying to sleep. To summarise, INMI will occur in situations that the individuals previously paired with music, and this prediction refers to the already-made, long-term associations that individuals have.

The second prediction is that INMI is the conditioned response of the continual combination of specific music with particular activities, according to the theory of classical conditioning. There is a predicted link between music and activities that is created involuntarily, when individuals systematically combine music with everyday activities. Consequently, these activities will be associated with the music that they were combined with, and in the case of the absence of music, the mind will fill in the gap with INMI. In other words, the expectation is that INMI will be able to be conditioned, and this process should be able to be generated in an empirical experiment. This prediction addresses to the newly-made links and, more specifically, regarding the activities, whereas the previous prediction involves uses and functions.

The third prediction is that INMI can serve a similar function to individuals as actual music. For example, if one values music greatly and considers it a pleasant experience, their INMI is most likely to be a pleasant experience. If music does not have special meaning to an individual, their INMI experience is probably indifferent and/or annoying, depending upon what their opinion to music is. Moreover, INMI will potentially act in the place of music, for example, as a coping mechanism.

As with music listening in everyday life, a level of overlapping is also apparent in these predictions. Despite the intersection, a series of empirical research studies were performed to test them in order to confirm or contradict this theory (see below).

1.3 Definition of INMI for this thesis

In this thesis, I opt for the term involuntary musical imagery (INMI), which I define as the experience coming into one's mind, unbidden. This experience can loop, or it can just play in the background, it can be triggered or it can come unsolicited, it can be persisting or feeble, or it may be distracting or helpful. In any form that INMI manifests itself, this thesis regards it as one experience as long as it is involuntary. On the experiments of this thesis, the participants were given the definition, but at the same time they were also asked about all imagery experiences, and were asked to further elaborate on their experience in order to include all types of experiences.

1.4 Methods

Involuntary musical imagery is, by definition, an unconscious and involuntary experience. Therefore, its investigation mainly involves retrospective measurements. Questionnaires (Liikkanen, 2008) are very accessible, therefore capable of assessing the experience for a wider population by increasing the number of participants and drawing statistical conclusions. Interviews have also been used by several studies, but again they are providing information of a self-reported, retrospective experience (Hemming & Altenmüller, 2012; Williamson & Jilka, 2014).

Several studies have attempted to evaluate the INMI experience by recording everyday life: diaries have often been used (Beaman & Williams, 2010; Halpern & Bartlett, 2011) as they provide an extra level of detail and personalisation. Bailes (2007) and (Cotter & Silvia, 2017; Floridou & Müllensiefen, 2015) made use of Experience Sampling Methods (ESM) by contacting their participants at random times throughout the day and inquiring about their musical imagery.

Lastly, there are some studies with experimental endeavours to induce INMI: Byron and Fowles (2013) created an experimental design where they aimed to induce INMI by manipulating familiarity, and later tested it through ESM, like Bailes (2007). Floridou, Williamson and Stewart (2016) devised an experiment in which they assessed the INMI induction through exposure to trigger-words under various cognitive tasks.

In this thesis, the aim was to minimise as much as possible the introspective bias that comes with the report methods, and the participants were either misinformed about the subject of the experiment, or were unaware of the hypothesis, as will be discussed later.

1.5 Overview of studies and predictions

Three studies have been designed to explore the hypothesis: two novel experimental studies, designed specifically for the purposes of measuring the conditioning premises of the hypothesis, and one experience sampling method study, which allowed assessment of the level of this association of music listening with INMI in everyday life, for a more ecologically valid approach. The next section provides an overview of the predictions that each study aimed to address, and further details on the chapters are provided on the Structure of the Thesis section, later in this chapter.

The first study, presented in Chapter 3, aimed to measure if and how INMI can be conditioned, and consequently generated in a laboratory-based manipulation. This study is an empirical study, concerning the pairing of an activity with music to examine the prediction that INMI will occur in situations previously paired with music. (See below for the detailed explanation of the chapters.)

The second study was based on the existing conditioning process of habitual music listening and, particularly, the element of mood regulation. This was another laboratory-based study, aiming to explore the premise that INMI will act in the place of music, and in that scope, as a mood regulation mechanism. The expectation of INMI occurring in situations previously paired with music is also assessed, as this study targeted individuals who use music for mood regulation purposes.

The third study aimed to assess how and if this association is manifested in the everyday lives of individuals, and whether there was an evident link between music listening and INMI. The expectations of whether INMI acts in the place of music, and whether INMI occurs in situations previously paired with music, will be assessed in a real-life setting.

1.6 Why study INMI and why this hypothesis?

The reasons behind why INMI happens are still unknown. For such a frequent phenomenon, that is INMI, further research and an attempt to decipher its mechanism will add to the understanding of the INMI experience, but also to the understanding of human behaviour and the mind. If an everyday activity, such as music listening, that takes place without any conscious intention can create this reverberation, such an association could be extended in other forms and combinations. Moreover, if this relationship of INMI and music listening actually exists, then INMI could potentially serve as a music therapy tool: the deliberate conditioning of music with activities or situations could help individuals cope with some of the challenges, but also profit from some the benefits of music in such situations (for example, music acting as a memory enhancer).

1.7 Structure of Thesis

As this chapter presented the main hypothesis, along with the expectations and experimental designs that this thesis is utilising, Chapter 2 outlines the literature relevant to this hypothesis and the larger topic of INMI. An overview of studies of musical imagery, music listening in everyday life, and conditioning theories are all discussed. In that chapter I present the existing literature on musical imagery, then proceed to music listening and the similarities music listening has with musical imagery, moving on to how memory for music works, memory in general, and an overview of the associative nature of learning, along with some of the main theories of conditioning. This overview aims to explain the rationale behind the hypothesis and give background evidence on how involuntary musical imagery may be a conditioned response to music listening. As INMI is an involuntary memory, Chapter 2 also presents a brief overview of some of the existing literature on involuntary memories, and a possible theory for INMI being more than that, due to the nature of music listening.

Chapter 3 reports the experimental process of investigating the possibility of a conditioning process with music and activities. This chapter is dedicated to the first study of this thesis, which was designed to explore if music can be conditioned by short-term training by combining it with a certain activity. The experimental design aimed to recreate the common function of music listening, that is, using music to accompany activities, and assess, after a short period of training, whether performing the activity would lead to music in the head.

Chapter 4 examines another prominent function of music listening in everyday life, that is, mood regulation, and how this aspect of music listening can relate to musical imagery. This study aimed to investigate the pre-conditioned associations with mood, via a mood manipulation experiment. By using the Trier Social Stress Test (TSST) paradigm, a mood manipulation was accomplished, and after a pre-screening procedure it was assessed whether involuntary musical imagery occurred when in an emotional state that was previously paired with music in the lives of the participants, and acted as a coping mechanism, in the place of music.

Chapter 5 explores this assumption in the everyday lives of the individuals, and the aim of the study was to evaluate the relationship between music listening and musical imagery (MI) in a real-life context. The method that was used was an experience sampling design which allowed me to look into individual uses of music.

In Chapter 6, a general discussion of the methods and the main findings of the previous chapters concludes this thesis, along with an overall discussion of the contribution to knowledge of musical imagery that this thesis has provided. Future studies and further possibilities for testing and developing the conditioning hypothesis are also discussed.

2 Involuntary Musical Imagery, Earworms, Music listening and Conditioning Theories: A literature review

Hearing music in one's mind can take many forms and is broadly described as musical imagination. Musical imagination consists of internal (cognitive) mental representations of a musical piece (Halpern, 1992) and it is necessary for both perceiving and creating (new) music (Hargreaves, 2012). On the other side, philosopher Sartre's view on imagination and the imagery acclaims that the act of imagination is a holistic imaginative experience, but in order to determine the characteristic of an image (or imagery) one has to reflect upon it and, moreover, one has to first have a knowledgeable, perceptual experience of said image (Sartre, 1940/2004). Thus, while imagination is necessary for perception, it is at the same time necessary to have a formed image in one's head, in order to be able to have it in one's mind. Peretz and Zatorre (2005) argue that in order to recognise a piece of music, one has to map it over (previously known) long-term representations (musical memories) containing the characteristics of the musical piece (p. 96).

Musical imagination, as a term, includes several aspects of internal music (re)playing: it can be of music that is already known, and therefore constituting a memory, or it can even be new music, like is the case with composition and improvisation (Hargreaves, 2012). Those mental replays of music are widely termed as musical imagery, which describes the experience of hearing a tune in one's head (Zatorre & Halpern, 2005). Musical imagery is divided into two main categories: voluntary and involuntary. Voluntary musical imagery is taking place when an individual actively and deliberately recalls a musical piece (Hodges &

Sebald, 2011). Voluntary musical imagery may occur when an individual imagines, remembers, or is actively thinking of a musical piece. Conscious control and volition of the action is the key discriminator between voluntary musical imagery and its counterpart, involuntary musical imagery, which is explored in detail in the next section.

2.1 Involuntary Musical Imagery

Involuntary musical imagery has further been described as music playing in one's head, coming unbidden without conscious control (Williamson et al., 2011, p. 259). As will be discussed later, several names and definitions have described the phenomenon, and a question arises on whether all researchers define it in the same way. As is often the case with research into human behaviour, many areas of research overlap with others: in this case, musical imagery overlaps with research of music listening, or memory, to name but a few. The following chapter provides a closer look into several aspects of the phenomenon, and while there was an effort made to keep those in separate sections under their respective subheadings, some elements keep being mentioned: for example, when musical imagery is examined from different perspectives, or when reporting involuntary (INMI) and voluntary musical imagery (MI) in musicians. That being said, the chapter is structured as first examining the phenomenon of INMI and the current findings from related research, then widening the scope to mental imagery (including auditory), continuing on with an exploration of music listening literature, which then leads to an exploration of memory and learning theories and how they may play a role in having music in one's head.

2.1.1 Anecdotal mentions

Over the years there have been numerous mentions of music playing in a person's head without them actively recalling it, in literature and pop culture references, as early as 1876 with Mark Twain describing a melody that one can only get rid of by transmitting it to another person (Twain, 1876). Popular television series have often mentioned the phenomenon: *Married with Children*, where the protagonist Al Bundy tries to remember the name of a tune 'stuck' in his head after hearing it on the radio (episode: 'Oldies Bun Young 'Uns'). A similar storyline appears in *The Big Bang Theory*, where the protagonist also has a tune stuck in his head whose lyrics connect to his current love problems (episode: 'The Earworm Reverberation'), while in *Doctor Who,* their earworm was designed to contain (and convey) clues for certain co-ordinates (episode 'Under the Lake'). While these mentions do not offer any substantial scientific evidence towards the phenomenon, they are important as they potentially reflect (or even shape) the wider audience's understanding of the phenomenon: an understanding which even current research on the matter has yet to fully unravel.

Some scholars have started discussing the phenomenon: Levitin (2006) refers to the 'stuck song syndrome', with musicians being theoretically more prone to it, and with potential links to obsessive-compulsive disorder (OCD) behaviours, while Sacks (2007) distinguishes the different experiences of musical imagery (having music in one's head) and 'sticky music'. The lack of any empirical evidence however, makes these suggestions worthy of further investigation.

One of the first published attempts to introduce the subject of musical imagery was from Brown (2006). He has recorded and analysed, at length, his own experiences of musical imagery, naming it a 'perpetual music track'. Brown (2006) had the ability of recognising and recording his episodes—being a trained musician (even if not a professional) and having a strong background of music theory and history. His self-report findings revealed a persistent musical imagery activity, with several episodes consisting of looping fragments of music. He mentions that the music appearing to loop the most is also the one he perceives as aesthetically pleasing and/or emotional. However, the experience is perceived as troublesome and distracting.

Brown's (2006) case-study reports have been one of the first attempts to record musical imagery experiences, but being a one-case study, and self-reported at that, it carries several major limitations. Research into the general population to assess the experience and characteristics of musical imagery followed shortly after, with Wammes and Barušs's (2009) follow up on Brown's (2006) project. Wammes and Barušs's (2009) study was a questionnaire study with sixty-seven participants, including both musicians and non-musicians. The name they used for the experience was 'Spontaneous Musical Imagery' (SMI), and it was described as 'a song stuck in their own head' (Wammes & Barušs, 2009, p. 38).

Another pioneer in the field of musical imagery is Freya Bailes (2006; 2007) whose work has included musical imagery in general, investigating both aspects of imagery: voluntary and involuntary. Her research (as seen later) involved university students of music, participating in an experience sampling study, regarding their musical imagery experiences.

2.1.2 Names and definitions

As seen above, the first research endeavours into the phenomenon of having music in one's head, all used different names and definitions. Consequently, one emerging point is the need for a consistent name and a clear definition across the literature. A glance at William's Classification of INMI Table 2, (Williams, 2015, pp. 7–8) suggests that there are several ways to name the experience of having music in one's head. Moreover, in the 'other characteristics' column, it is apparent that, besides the differences in the names, some differentiation also emerges in the definitions. Research on the subject started by adopting the term 'earworms': initial references to the phenomenon (Halpern & Bartlett, 2011; Levitin, 2006; Wammes & Barušs, 2009) assumed that it was a bothersome experience, and indeed not happening very frequently. As will be analysed later, interestingly, a similar progression happened in the timeline of involuntary semantic memories, as they are very similar experiences that follow similar timelines. Earworms (from German Ohrwurm) were described as songs that are stuck (Wammes & Barušs, 2009) and often annoying (Halpern & Bartlett, 2011). Floridou Williamson and Müllensiefen (2012) call it 'a short melody getting stuck in the mind and being heard repeatedly' (p. 302). This experience may be true for some of the music in the head episodes, but later research suggests that it is not the case for all. Indeed, despite the given definition, Wammes and Barušs's (2009) findings suggest that the experience was not bothersome for the majority of cases. Sacks (2007) differentiates the 'music on the brain' or imagery with being pleasant, from 'brain worms' as being annoying; this distinction is in fact prominent, as the two experiences feature in different chapters and are not linked in his discussion. Since Liikkanen (2008) introduced the term INMI, many researchers have opted for that, while the term 'earworms' is still being used (Margulis, 2014), and often interchangeably. This creates a further issue, as people often have a predisposition of the earworm being annoying and repetitive, or stuck. Therefore, the need for further detail on definition in research papers, both when introducing the term to participants, and as a general research scope, is prominent.

On the problematic side of musical imagery lay musical hallucinosis, musical hallucinations, and musical obsessions. All of them are considered clinical phenomena, with pathological (in the case of hallucinosis) or neurological foundations. Hallucinosis is a term mostly used in (acquired) deaf individuals, with no neurological conditions (Colon-Rivera & Oldham, 2014), who experience a form of musical hallucinations, with the equivalent blood flow in areas associated to the auditory system (Kumar et al., 2014). Musical hallucinations are described as episodes where the individual perceives the experience as real, as described by Hemming and Merrill (2015), and are often met in patients with deafness, with psychiatric conditions (such as depression, schizophrenia, obsessive-compulsive disorder, and alcoholism), or neurological conditions (lesions in the brain). Musical obsessions, on the other hand, often accompany behaviours of the obsessive-compulsive spectrum, and are described as ‘an obsessional imagery that is recurrent, persistent, intrusive, unintentional, time consuming (i.e., more than an hour per day), and cause distress or functional impairment’ (Taylor et al., 2014, p. 582). However, these cases of musical imagery are not often experienced by healthy individuals, and the INMI research mainly focuses on the INMI experiences of the wider population.

2.1.3 Prevalence

The most extensive study on prevalence of the INMI phenomenon so far has been run by Lassi Liikkanen (2011), who investigated the phenomenon by using online questionnaires in a vast corpus of participants (*N*=12,519). Liikkanen introduced the term involuntary musical imagery, abbreviated as INMI, as a mental replay of music being remembered involuntarily (Liikkanen, 2008. p. 408). The results of his large-scale study (2011) suggest that 89.2% of his pool of participants reported experiencing INMI at least once a week. This finding underlines the relevance of INMI in everyday life.

Bailes (2007) conducted an experience sampling (ES) study to investigate the prevalence of musical imagery in general (without discriminating over involuntary or not). Her findings show that music has been imagined on 43% of the total episodes reported (Total ES probes=417, N=11). In another experience sampling study, with a larger corpus, music was imagined 25% of the time (Total ES probes=4,403 in Cotter & Silvia, 2017).

2.1.4 Factors for INMI

2.1.4.1 Musicality

Musical engagement seems to play a role in the way people experience INMI. Beaman and Williams’s (2010) findings suggest that musically engaged individuals, meaning people who consider music to be important, are more likely to have frequent, and problematic INMI. Liikkanen's (2011) findings also suggest that engagement in musical activities can be a predicting factor for experiencing INMI, with musicians reporting longer and more instrumental segments. The data also showed a positive association with INMI and increased music practise and listening. Other papers however, have found only weak associations between frequency of INMI and musicianship: there is some evidence that with more advanced musical training, INMI frequency tends to have lower ratings. Williamson and Jilka's (2013) findings suggest that the musicians in their interview group experienced INMI less often, while Liikkanen's data (2008; 2009; 2012) suggest that those with little or moderate musical training were more likely to experience INMI often. In fact, Hyman et al. (2013) suggest that exposure to music, regardless of musical training, leads to more frequent INMI.

2.1.4.2 Familiarity

Beaman and Williams's (2010) findings also suggest that the imagined music is mostly familiar, although they do not discriminate if it is of musical taste or not. Halpern and Bartlett's (2011) findings, however, do indicate that besides familiarity, musical taste seems to play a role in experiencing INMI. In particular, they report that: 'People seem to replay mentally the music that they like (which may also be the music they expose themselves to), even if it is unconsciously done' (Halpern and Bartlett, 2011, p. 428).

Halpern and Bartlett's (2011) given definition for the phenomenon was that this 'involuntary mental imagery is generally held to be annoying and/or distracting' and is being described as 'persistent episodes of musical retrieval', or 'persistent musical memories' (p. 425). Nevertheless, their findings indicate that for a large majority of their participants the experience was pleasant. Moreover, Hyman et al. (2013) suggest that tunes that people 'know and like' are more likely to appear as INMI, and are often being intrusive (p. 204).

2.1.5 Categories of INMI occurrence

Research on INMI indicates that INMI happens in certain circumstances: Williamson et al. (2011) found that recent exposure is one of the most reported reasons for one to be experiencing INMI. The next category, according to Williamson et al. (2011), is memory triggers, i.e. a word or another element triggered the memory of the music of the INMI; and the categories that follow are affective states (meaning when one is emotional), and low attention states (when for example one is absent-minded or bored). Similarly, Halpern and Bartlett (2011) revealed that for 56% of their participants, the episode was triggered by an event: something that reminded them of a piece of music (lyrics, etc.).

Bailes's (2007) results also suggest recent exposure as the main reason for triggering musical imagery (MI) in musicians, either voluntary or involuntary (58% of participants). Bailes's research included both Voluntary Musical Imagery (MI) and Involuntary. These results however, could not reflect the general population, as the pool of participants used was small ($N = 11$) and they were all music students. In a follow-up study however, exploring musical imagery in a wider population, Bailes's (2015) findings suggest that recently heard music accounts for 37.7% of all INMI episodes.

2.1.6 Trait and state personality factors and INMI

Personality factors could explain why some people have INMI in different ways, that being often, or looping, or constant, or annoying/pleasant. Indeed, several studies suggest that personality traits have often been found to be correlated with INMI: Wammes and Barušs's (2009) findings suggest that higher scores on transliminality correlated with the occurrence of persisting and distracting INMI. Transliminality, in this context, is defined as a susceptibility to, and awareness of, inwardly generated psychological phenomena (Wammes & Barušs, 2009, p. 39). Other traits have also correlated to INMI: Beaman and Williams (2010) found that schizotypal personality is positively correlated with the prevalence of earworms, while

Williamson and Müllensiefen (2012) found some minor correlations between obsessive-compulsive traits and INMI being frequent and disturbing. Neuroticism has often been found to correlate with INMI: Floridou, Williamson and Müllensiefen (2012) found neuroticism to be correlated with several INMI characteristics, such as with INMI being pleasant, being controllable, lengthy, interfering, worrying and with strategies employed to get rid of INMI. Beaty et al. (2013), found that neuroticism was a modest predictor on how often people experienced musical imagery. Moreover, Beaty et al.'s findings suggest that neuroticism predicted having a 'song stuck in the mind' experience. Openness to experience was also found to correlate with INMI by various research findings: Floridou et al. (2012) found correlations between length of INMI and how interfering INMI was, and Beaty et al. (2013) found that openness to experience was a large effect predictor to frequency of musical imagery.

2.1.7 Characteristics

Another possible lead to unravelling the occurrence of INMI was intuitively looking at the music that plays in the mind, and, specifically, at its musical characteristics: Finkel and Müllensiefen (2012) suggested that it could be the attributes of specific songs, in terms of musical structure (Finkel and Müllensiefen, 2012). Williamson and Müllensiefen (2012) have also investigated the musical elements that could contribute to INMI and found that the distribution of intervals and the tone durations (or in other words longer notes and smaller intervals) that often are met in pop music, seemed indeed to predict INMI of that music.

2.1.8 Looping INMI

Several papers characterise INMI as looping fragments of music (Williamson et al., 2011; Halpern and Bartlett 2011). Even though the looping effect is reported often (Bailes, 2015), the exact number of the looping episodes over the non-looping ones is not clarified. Beaman, Powell and Rapley (2015) and Hyman et al. (2013) suggest that INMI is an indicator of cognitive load and lack of mental control or low working memory capacity. Indeed, this may be a matter of working memory, and how much information can be retained (especially by non-musicians), or it can be traced back to the phonological loop (Baddeley, 2000).

2.1.9 Valence of INMI

Music playing in one's head is generally a pleasant experience (64% in Halpern and Bartlett, 2011), and one of the elements that seem to make it unpleasant is repetitiveness (Williamson & Jilka, 2014) which leads to the feeling of it being intrusive (Hyman et al. 2013). Filippidi and Timmers (2017) found a correlation between pleasantness of INMI and musical engagement: if a person was not engaging in music listening, they then had more chances of experiencing annoying INMI. Liikkanen (2011) found out that musical imagery is considered to be the most annoying form of involuntary semantic memory, while coping mechanisms have often been found to be employed to eliminate the INMI (Beaman et al., 2015; Williamson, Liikkanen, Jakubowski, & Stewart, 2014).

2.1.10 Catchiness and INMI

'Catchy' music has often been investigated as the reason for having music in the mind: Hemming (2009, as cited in Hemming, Merrill, Hemming, & Merrill, 2015) employed a methodology in which the participants were asked to listen to a CD comprising potentially 'catchy' music, for several weeks. The findings from this study were that INMI from the playlist indeed occurred after the period of music listening, and often when participants were relaxed, or engaged in physical activity. The latter corresponds to Williamson et al.'s (2012) low attention states. However, as will be discussed later in the chapter, it also corresponds to music listening functions, as people often listen to music when in those states.

Even though researchers and participants alike seem to have a good knowledge on what 'catchy' is, a closer look at the literature reveals a gap on a clear definition of what ‘catchy’ is and what constitutes ‘catchiness’. Honing (2010) put forward the notion of ‘musical hooks’—certain phrases or elements that characterise a musical piece and ‘draw’ the listener to them: those phrases are, potentially, easy to remember and are what the listener remembers from the piece. As a follow-up, Burgoyne, Balen, Bountouridis, and Honing (2013) designed an experiment that is described as a ‘game with a purpose’, exploring how fast a musical piece would be recognised from exposure to certain passages on different musical pieces, and their initial findings suggest that certain fragments indeed have different (better) response times in recognition.

2.1.11 Genre of INMI

The exploration of certain characteristics of music being responsible or the explanation for music being stuck in the mind is reasonable, however, in that case, as music has top-charts, so should INMI. Research, however, in the top charts of INMI showed little evidence that this was the case: from 1558 INMI reports, only 33 reports were about the same piece (a song by the artist Lady Gaga) in a study by Jakubowski, Finkel, et al. (2016). Bailes’s (2015) findings also reveal low ratings: Michael Jackson appears a total of 7 times (from 6 respondents), out of 1415 experience sampling reports (reportedly, this study coincided with the time of his death, where his songs and tributes about him were broadcasted largely). Pop music seems to prevail in both musical elements of INMI and in the genre reported. However, as will be discussed later, pop also appears to be the genre that is preferred by the majority of listeners. As additional evidence on the subject of genre, Beaty et al. (2013) explored genres of music listening as predictors of INMI, rather than correlations between music listening and INMI. Their findings showed that genres that are considered as reflective and complex, such as classical, jazz and folk, or intense, such as alternative, heavy metal and rock, were related to the frequency of INMI. The imagined music is often music with lyrics (Bailes, 2006; Beaman & Williams, 2010), with musicians having the higher rates for instrumental or new music as INMI (Liikkanen, 2011).

2.1.12 Music listening and INMI

While recent findings have suggested that musical engagement and musicality seem to correlate with INMI, music listening behaviour is more problematic. Sacks (2007) discusses his own music listening behaviour, focusing on 'fixations' as he calls them: he mentions listening to a certain music on repeat, and after having done so, involuntary musical imagery of that music would appear (Sacks, 2007, p. 34). These episodes are described as involuntary musical imagery, and not categorised as 'sticky music', which he mentions later in the book. Instead, Sacks lists them under associations as he discusses later musical associations. Margulis (2013) also discusses repetition in music, as opposed to speech, attributing the phenomenon of earworms to the repetition of music. Filippidi and Timmers (2017) found a further relationship between music listening and musical imagery: their study showed that functions of music were often similar in listening and imagery, which they attribute to a conditioning process that may take place, very similar to the priming effect proposed by Kvavilashvili and Mandler (2004).

2.1.13 Inducing INMI

As INMI is such a fleeting experience, and the involuntary component is elemental, several researchers have attempted to induce INMI with lab techniques in order to investigate it. Byron and Fowles (2013) created an experiment where they investigated the influence of recency and repetition on INMI. Their participants became familiar with previously unknown songs, and this resulted in INMI. Their results also indicate that autobiographical associations to these songs proved to be a strong predictor for later INMI of the songs. These studies show how even short-term training due to music listening can enhance INMI. Liikkanen's (2012) research also suggests that INMI can be experimentally induced and recent exposure can be a ‘facilitating factor, but not a necessary condition’ (Liikkanen, 2012, p. 217). Furthermore, Floridou et al. (2012) designed an experiment where participants were prompted to experience INMI by being exposed to some ‘catchy’ lyrics before the task they were to perform, to assess differences in cognitive load. Their results showed a figure of 65% of INMI on the baseline task, with the low cognitive task following (although with lower rates), which suggests that INMI may relate to spare cognitive capacity (Floridou, Williamson, & Stewart, 2016). Another INMI induction experiment explored the association of INMI with motor involvement, where the findings suggest that singing and tapping along with the music has the potential to trigger INMI more frequently than passive listening, but the interruption of a tune does not (McCullough, Campbell, & Margulis, 2015).

2.1.14 Ability of musical imagery

With regards to ability in musical imagery, there is some evidence that musical training plays a role: Aleman et al. (2000) found that musicians performed better on musical and auditory imagery tasks than non-musicians, whereas performance on visual imagery tasks was similar for both groups. This is understandable, as musicians often experience (or even create on demand) musical imagery when reading musical scores (Brodsky, Henik, Rubinstein, & Zorman, 2003).

Involuntary musical imagery, on the other hand, does not seem to enhance performance on the accuracy of voluntary musical imagery: Weir, Williamson and Müllensiefen (2015) designed a study for individuals who reportedly had either enhanced INMI or not, and advanced musical training or not, and their aim was to assess whether these factors would affect the ability of musical imagery. Their findings suggest that musicians performed better in terms of pitch, but the group with enhanced INMI performed no better than the low INMI group. Interestingly, all groups performed similarly in the timing task.

Other musical features also seem to have accurate mental representations: loudness is imagined accurately by musicians (Bishop et al., 2014), whilst imagery for tempo appears to be generally accurate regardless of musical training (Jakubowski, Farrugia, & Stewart, 2016; Jakubowski, Halpern, Grierson, & Stewart, 2014; Levitin & Cook, 1996).

2.1.15 Musical training

Musicians seem to use voluntary imagery as a training tool in order to rehearse and learn difficult passages (Lotze, Scheler, Tan, Braun, & Birbaumer, 2003). Lotze et al. (2003) pointed out that, during this mental practice, several parts of the brain are activated, such as motor, somato-sensory and auditory related areas. Similar associations between different parts of the brain were suggested by Godøy; he supports that gestural imagery and MI are closely linked, and one can trigger the other (Godøy & Jørgensen, 2001). The findings of Bailes's (2007) study also suggest conscious use of musical imagery by musicians: individuals reported experiencing musical imagery when preparing for performance or trying to memorise a musical piece.

2.1.16 Brain and musical imagery

Voluntary imagery is suitable for investigating how imagery is perceived by the brain, as it can be recalled voluntarily and deliberately. Zatorre, Halpern, Perry, Meyer, and Evans (1996) conducted a PET scan study investigating brain activation in perceived and imagined music. Their results showed significantly similar neural activation in both situations, in terms of cerebral blood flow. Further activation in the imagery state was noted in the frontal lobe, an area related to the retrieval of musical semantic memories (Halpern & Zatorre, 1999). Furthermore, Schubert, Evans, and Rink (2006) and Lucas, Schubert, and Halpern (2010) showed that there is a strong similarity between the processing of emotion in heard and imagined music. Moreover, there is further evidence that when asked to imagine music, musicians also exhibit some brain activation in areas associated with vision or motor (Herholz, Halpern, & Zatorre, 2012; Janata, Tomic, & Haberman, 2012).

The first endeavour to investigate INMI in the brain has been by Farrugia, Jakubowski, Cusack, and Stewart (2015), in which they examined the relationship of INMI and brain structure. In this study, they used a database of already-acquired brain scans, and they correlated brain structure to certain characteristics of INMI based on the participants' responses on the Involuntary Musical Imagery Scale (IMIS, by Floridou et al., 2015). Their findings showed a correlation of frequency and experience of INMI with cortical thickness in the regions of fronto-temporal, cingulate and parahippocampal areas (Farrugia et al., p. 74). In other words, participants who experienced INMI frequently and/or experienced pleasant, annoying, or emotional INMI, also had brain structural differences in areas that are related to auditory perception, auditory images, voluntary musical imagery, and pitch memory. This was a very important first step towards a better understanding of the phenomenon of INMI, however, this was a post-hoc exploration, with correlational nature, and it did not convey any findings on what the INMI looks like in the brain.

This section presented some of the main findings of the involuntary musical imagery literature, along with some relevant to the hypothesis studies of voluntary musical imagery. The next section will provide an overview of the aspects of music listening in everyday life that justify the reasoning of our main hypothesis.

2.2 Music listening

Clayton (2014) highlights that music, ipso facto, is a human behaviour, rather anything else; whilst music is referred to as an individual item (i.e. the music in everyday life, or the music is pleasant), it is useful to think that human production is always implied. In a similar spirit, DeNora (DeNora, 2000) speaks of affordances in music: music has the potential to enable behaviours and situations, rather than actually being responsible for it.

While Pinker famously argued that music is merely an indulgence, an 'auditory cheesecake' as he puts it (Pinker, 1997), music is a constant factor through centuries and cultures (Clayton 2009; Levitin, 2006; Mithen, 2005; Montagu, 2017). In our modern world, music is more present than ever - (and one might argue, more than ever disassociated with human deed) with the purpose of accompanying, changing or enhancing our everyday lives (Levitin, 2007).

2.2.1 Everyday music listening

The role of music in everyday life has preoccupied scientists for a long time. In 1978, Dees and Vera began to explore the social occasions and the effects of music in the frame of everyday life (Dees & Vera, 1978), and the subject is still under exploration by many researchers.

Music listening still holds a very important role in modern everyday life: an experience sampling method, well after 20 years since Dees and Vera's (1978) study, showed that music was heard in 44% of all reports (Sloboda, O'Neill, & Ivaldi, 2001). People tend to dedicate a significant part of their day to their music habits (Greasley & Lamont, 2011), with times varying from three hours per week for the less engaged individuals, to an impressive forty hours per week (similar commitment to that of a full-time job) for the more engaged.

2.2.2 Music and functions

One of the first papers exploring music in everyday life was by Hargreaves and North (1999), where they put forward the notion that functions in everyday music listening can be explored under three different domains: the cognitive, the emotional, and the social domains. As music is multifaceted, it can serve more than one purposes at the same time.

The ways and reasons that people choose to listen to music are well documented in the literature (Greasley & Lamont, 2011; Juslin & Sloboda, 2010; Lonsdale & North, 2011). For many studies, affect regulation seems to be the most prominent factor for listening to music (Juslin & Sloboda, 2010; Lonsdale & North, 2011). Lonsdale and North's (2011) findings indicate music as background noise as another popular musical activity (75.66%, *N*=189), followed by musical participation (to sing along, to dance). The categories that followed were: to reflect on the past (34.92%), music as an enjoyable experience (57.14%), social interaction (25.40%), and music as a distraction (40.21%) (Lonsdale & North 2011). The ratings do alter slightly across studies, for example, the category of music as an enjoyable experience yielded a slightly higher rating in Greasley and Lamont's (Greasley & Lamont, 2011) study with 62%.

While the above functions occur in the general population, it seems that the occurrence changes across the life span. Groarke and Hogan (2015) found that the popularity of certain categories of music listening varies with age: younger individuals opt mostly for mood improvement (meaning that they are already in a certain mood, and want to maintain/enhance it), while older individuals opt for listening to music to induce positive moods (meaning that they aim to induce the wanted mood).

A further suggestion comes from a cross-cultural study (Boer & Fischer, 2012) exploring the threefold of musical experience mentioned above, proposed by Hargreaves and North (1999), comprising social, cognitive, and emotional functions of music. Their findings showed that while there are several similarities across the four different cultures they investigated (Anglophone Western, Non-Anglophone Western, Asian, and South-American), there were also some differences. The aspects that were significantly different between the cultures were the emotional function, as well as the memory function, while diversion (listening to music as a distraction) was also flagged as significantly different between the cultures (Boer & Fischer, 2012). This suggests that culture and way of life will effectively result in different uses of music, to some degree.

2.2.3 Music and emotion

Research shows that music has the potential to enhance, or even provide strong emotional experiences (Gabrielsson, 2011). Music may assist in relieving stress, in regulating mood (DeNora, 2000), or in evoking pleasant memories (Janata et al., 2007). Similarly, Hargreaves and North's (1999) study showed that music acts as a means to help people cope with certain situations; their experiment showed that, when music was involved, people were more willing to prolong their waiting time in given situations. Sloboda et al. (2001) found that in most cases, everyday music listening was combined with activities. In these cases, participants reported feeling more energetic, focused, and positive about their day, especially when listening to self-chosen music.

2.2.3.1 Mood regulation

Music has also been shown to effectively help individuals in regulating their mood, and is capable of acting as an enhanced coping strategy (van Goethem & Sloboda, 2011). Music, in some cases, has been found to act as a tool to improve negative feelings and act as a method of 'mood management' (Lonsdale & North, 2011). To investigate mood regulation, Saarikallio (2008) devised a questionnaire (Music in Mood Regulation, MMR) which allowed an investigation of the prevalence of certain mood regulation strategies. Her findings in an adolescent population, showed that the main mood-related categories of music listening are: entertainment, revival, strong sensation, diversion, discharge, mental work, and solace. Saarikallio's (2008) findings also suggest that adolescent girls used music as a mood regulation strategy more often than boys.

Mood regulation strategies seem to change with the level of engagement: Greasley and Lamont's (2011) findings suggest that moderately engaged individuals would more often choose music to create, change or enhance their mood, than the most or least engaged ones.

2.2.4 Musical preference

In the 1960s, the psychologist Daniel Berlyne proposed a model that suggested that pleasure depends on interest and complexity (Messinger, 1998). Anthony Chmiel and Emery Schubert (2017) revisited this theory, as a model for preference of music, by analysing data from 50 studies. Their findings suggest that there is enough evidence to support this revised model, concluding that the level of arousal seems to play a role in musical preference.

Moreover, enjoyment of music listening seems to relate to the level of control: a study by Krause and North (2017) suggests that the more control individuals have over the music listening situation, the more enjoyable the experience is for them. Dominance on location and music type (whether it was self-chosen or not) seems to affect the overall listening experience (Krause & North, 2017). Indeed, North et al.'s (2004) findings also suggest that while music was rated as pleasant and positive when their participants had chosen to listen to music, when they did not choose, the rating of music being annoying was considerably higher.

The parameters that define musical preference are highly individualised: personality traits, cultural and biological influences, and musical features are all elements that potentially influence musical preference (Greenberg, Baron-Cohen, Stillwell, Kosinski, & Rentfrow, 2015; Greenberg, Müllensiefen, Lamb, & Rentfrow, 2015; Lamont & Greasley, 2009; Rentfrow & Gosling, 2003). There are, however, elements that are common in musical preference: physiological arousal elicited by music, and music serving a cognitive function, can both determine musical preference (Schäfer & Sedlmeier, 2010). Moreover, there is some evidence that musical preference correlates with improved performance on remembering a piece (Stalinski & Glenn Schellenberg, 2013). Lastly, there are certain genres that are rated as most preferred; pop music is listed as the most preferred genre (North et al., 2004), even though it is often considered as 'bad' or a 'guilty pleasure' (Washburne & Derno, 2004).

2.2.5 Repetition

The role of repetition in music has long concerned academics and it entails two different aspects: on the one hand, there is repetition as in the musical structure, i.e. musical or rhythmic forms that repeat throughout a musical piece (Bigand, Tillmann, Poulin-Charronnat, & Manderlier, 2005), and on the other, there is the idea of repetition in music listening, i.e. listening to a piece over and over (Margulis, 2014). Unlike any other activity, we aim to repeat music (albums heard over and over again, repeating pieces that one enjoys, and similar uses of music with similar/particular genres for certain activities) (Middleton, 1983). That repetition seems to increase enjoyment (Hargreaves, 1984), but only in moderate doses: by using the model of the inverted-U described above, Hargreaves suggested that there is a pleasure and preference increase with repetition, but only to a point. After that point, further repetition decreases pleasure, just as in a U-shape (Chmiel & Schubert, 2017).

Margulis (2014) discusses that the need for repetition in music may derive from the evolutionary need for language; in order to learn how to communicate, humans need to pay attention to vocalisation, register the sounds and repeat them, just as children learn how to speak. Therefore, repetition in music may derive from our cognitive 'need' to learn languages, and ultimately, to communicate.

2.2.6 Personality

Many studies have investigated the role of music in personality, alongside everyday life activities (Hargreaves & North, 1999; Krause, North, & Hewitt, 2013; Rentfrow, Goldberg, & Zilca, 2011). Several traits have often been found to associate with certain musical behaviours. For example, individuals who exhibit neuroticism personality traits, have also reported listening to music for emotional uses (mood regulation). Extraversion has been associated with background use (studying, driving, or working), while openness to experience has been connected to intellectual or cognitive use of music (i.e., experiencing music in a rational way or using it for intellectual stimulation) (Chamorro-Premuzic, Fagan, & Furnham, 2010).

2.2.7 Associations in music

Music creates a very prominent ground for associations, either by using extra musical meaning (Koelsch, 2012), or simply by trying to make sense of the world through it (Mithen, 2005). Music has the potential to bear associations of other modalities: pitch has often been found to be connoted with size and spatial height (Eitan & Timmers, 2010; Fernández-Prieto, Navarra, & Pons, 2015), gestures (Camurri, Mazzarino, Ricchetti, Timmers, & Volpe, 2003), and language (Forceville, 2009).

Music is also an effective way of organising and enhancing memories of past experiences (Cady et al., 2007), to the point that listening to that music can create feelings of 'reliving' the moment (Baumgartner, 1992). The role of music in autobiographical memories has been discussed by many: Proust (1913) describes how his character Swan has associated a specific piece of music with his love for Odette, and his pleasure from the music fluctuates along with his feelings. Empirical research shows evidence that personal associations with music may create an emotional meaning for music, which gives that music additional emotional attributes (Janata, 2009; Schulkind, Hennis, & Rubin, 1999), especially in older populations (Platz et al., 2015). Those associations can be enough to induce changes in emotion-related memory and judgement (Vuoskoski & Eerola, 2012), or nostalgia (Janata et al., 2007; Michels-Ratliff & Ennis, 2016).

2.2.8 Well-being

As reviewed above, music has the potential of being associated with other elements, but also with memories. However, the reason that we like music may be beyond mere associations. Menon and Levitin (Menon & Levitin, 2005), in their research, showed that listening to a musical piece for the first time, releases dopamine. Further analysis of the correlations with brain activation indicates that music creates a reward-releasing mechanism, just like a pleasant activity does (Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009). Thus, it appears from these studies that music can be perceived as a reward, as it activates structures in the dopaminergic system (Gebauer, Kringelbach, & Vuust, 2012).

In everyday life, people seem to intuitively know about this function, as they often tend to use music as a reward mechanism (Ernest et al., 2013). Pleasurable music has the potential to improve performance in tasks (Gold, Frank, Bogert, & Brattico, 2013), although again, individual factors seem to play a role in the level of reward perceived (Mas-Herrero et al., 2013).

People often listen to music to reduce anxiety (MacDonald, Kreutz, & Mitchell, 2013; Vella & Mills, 2017), enhance positive feelings (Krause et al., 2013), and enhance their well-being (Groarke & Hogan, 2015). Juslin and Västfjäll (2008) argued that while music indeed elicits emotions, the framework in which it operates is based on other mechanisms, such as brain reflexes, emotional contagion, or evaluative conditioning.

2.2.9 Music listening as training

The conditioning hypothesis of this thesis dictates that there should be a prerequisite of a training effect: if music listening in everyday life is enough to 'create' a conditioned response, that is INMI, then this training should be apparent in other aspects as well.

The literature documents well the differences resulting from musical training (in terms of musicianship and actively playing music) with musicians having acquired certain transfer effects (Besson, Chobert, & Marie, 2011), as musicians appear to develop some other differences to non-musicians besides their musical skills. Brain-imaging studies of a musician's brain indicate that music training results in significant differences. Gaser and Schlaug (2003) found differences in musicians' and non-musicians' grey matter: differences in volume in auditory, motor and visual-spatial regions of the brain. Moreover, Bhattacharya and Petsche (2005) found that musicians and non-musicians had different functional and topographical connectivity patterns during attentive music listening.

Music training appears to cause differences in the brain, and Hyde et al. (2009) found that just 15 months of music training were enough to notice structural changes related to motor and auditory skills. Moreno et al. (2011) showed that a mere 20 days of musical training on children was enough to enhance their performance in untrained cognitive abilities, and 6 months of musical training would be enough to improve reading and pitch discrimination (Moreno et al., 2009).

However, there is growing evidence that even music listening has the potential to result in differences as well. Angelucci et al. (2007) have experimented with music exposure in mice and found an influence on neurotrophin production in the hypothalamus part of the brain of the music-induced mice. This, according to them, may explain the physiological positive effects of music on mood improvement, mood, cardiac heartbeat, blood pressure etc. Sarkamo et al. (2008) conducted a study on stroke patients and explored the effect of everyday music listening and everyday exposure to language (audiobooks), with the control group receiving no listening material. The music group improved significantly in comparison to the control group and the language group, in the domains of verbal memory and focused attention, with significant improvements of mood as well. In another brain imaging study, investigating the beneficial effects of music listening in stroke patients, Sarkamo and Soto (2012) found that everyday music listening can produce structural grey matter changes, with noticeable improvements on auditory and verbal memory, focused attention, mood, and with a further short-term improvement on visual awareness in patients with visual impairments.

All the above indicate that, indeed, music training does affect the brain and, while undoubtedly music training consists of much more than music listening, there is also some promising research showing that music listening has beneficial effects too. If the effect of music listening is also evident (as opposed to non-listening) then the theory of this thesis may be tested further: if music listening comes in a pair with INMI, then this would potentially lead to differences across participants (in potential brain studies), that would be possible to investigate.

2.2.10 Musical memory

The way to remember music is at its core to imagining music. When Cook (1990) discussed the matter of music memory, he used the analogy of the 'illusion of immanence', in which one can have the image of the Pantheon in their mind, but one cannot count the columns from that image (Cook, 1990, p. 90). According to Cook, music is likely to be organised into non-concrete memories that have musical attributes. Sloboda (1985) discussed the empirical evidence of the difficulties of individuals in reproducing a simple melody by memory. However, findings from a neuroscientific perspective suggest that when pianists were asked to memorise a piece by setting specific sections of it as markers, the recognition and identification of those sections was faster than the other parts of the piece (Williamon & Egner, 2004). This study, however, used trained musicians who were also instructed to memorise that piece, so specialists may perform differently than non-musicians. Snyder (2000) argues that musical memory works by employing 'chunks': groups of musical elements define a 'chunk' in short-term memory, and the associations upon the 'chunks' are what makes music make sense (Snyder, 2000, p. 54).

2.3 Memory

Memory is what helps us make sense of this world; all information has been stored and is being retrieved when necessary, the skills, how to speak, how to walk, all come down to learned and stored information (Thompson, 2000). Memory is divided by scholars into two broad categories: Explicit and Implicit (Snyder, 2000). Explicit is the category regarding facts and events, otherwise known as declarative, whereas Implicit includes non-declarative processes such as the development of skills and habits, priming, associative learning and reflexes (Thompson, 2000, p. 365), and elements that often are not conscious. Implicit memories can often include ‘motor memories’ (Snyder, 2000) or skills, ‘a knowledge of how to do things’ (Snyder, 2000, p. 73) with no necessary consciousness of the process. In this chapter, I focus on implicit memory, and more specifically, on associative learning.

Learning and conditioning are terms whose meaning is intertwined; however, each one leads to different paths. Learning can certainly be a conscious process (Doyon & Benali, 2005), involving expectations and regular feedback (Grossberg, 1999). Conditioning, on the other hand, appears to be a more automated process, often with no immediate realisation of it (Mitchell et al., 2009). Nevertheless, these two terms go hand in hand, as conditioning would not be possible without a prior process of learning (Anderson, 2000).

Mackintosh’s definition of conditioning is that which ‘involves the mapping of relationships between events’ and the key point is to find these relationships that ‘produce conditioned changes in behaviour’ (Mackintosh, 1983, p. 11). As he elegantly puts it: ‘Conditioning can be regarded not as the acquisition of new reflexes, but rather as the acquisition of new knowledge about the world.’ (Mackintosh, 1983, pp. 10–11). Mackintosh supports that it is the behaviour of the subject, after exposure to the relationship, which denotes the occurrence of conditioning.

In the classical conditioning theory, first proposed and explored by Pavlov (1927), as discussed briefly in the introduction chapter, two stimuli that become repeatedly paired will become so associated to each other that one may solicit responses that were corresponded only to the other. In the typical, classical conditioning a neutral stimulus (named conditioned stimulus or CS) is repeatedly paired with another stimulus (unconditioned stimulus), one that elicits a response (unconditioned response). After adequate training in the combination, the mere exposure to the conditioned stimulus would by itself be enough to elicit the unconditioned response, which, after the training and successful association, would become the conditioned response (Moore, 2002). In Pavlov's original experiment, the subjects were dogs, the conditioned stimulus was a bell, the unconditioned stimulus was food and the unconditioned response was salivation. After the training period, the dogs would start salivating only by hearing the bell, which proved that the unconditioned response had in fact become conditioned (Pavlov, 1963).

Skinner (1974) on the other hand, supported that classical conditioning is too simplistic to explain human behaviour and learning, and proposed the theory of Operant (or Instrumental) Conditioning. Skinner based his theory on the works of Watson and on Thorndike's law effect and he proposed that it is the individual's actions and the consequences of those actions that shape the conditioning process. The individual's behaviour is thus changed by some kind of reinforcement that establishes the newly-founded association (Anderson, 2000). In other words, it is the actions of the individual, based on the consequent reactions from the environment, that form the association. These reinforcements may be positive or negative, with the expectation that positive reinforcement will strengthen said behaviour, whereas negative reinforcement aims to weaken it.

As an evolution of the conditioning theories above, the theory of secondary conditioning proposed another level of association that may take place without the use of a primary reinforcer, and instead, two neutral stimuli can become associated (Gallistel & Gibbon, 2013). Priming, on the other hand, is another process that is also close to conditioning and associative learning. Priming, however, refers to the improvement of the response to one stimulus, due to exposure to another: for example, priming is involved when the word 'green' has a faster recognition response when written in green (Thompson, 2000).

Another theory that progresses the conditioning model is the model of evaluative conditioning (De Houwer, Baeyens, & Field, 2005). In evaluative conditioning, the valence of the neutral, conditioned stimulus changes due to its pairing with a positive or negative unconditioned stimulus (Mitchell et al., 2009), and these contingencies (one stimulus depending on the other) are crucial to create the conditioning process.

The above theories have been researched and have evolved through the years, as the level of understanding cognition and the mind has increased. The above theories seem intertwined, and the connection between them is the mind and its ability to draw conclusions and make associations that will help it make sense of the world. Conditioning is a fundamental associative learning process, which involves the learning of an association between two stimuli (one neutral and one that elicits a response). Perruchet and Gallego (1997) support that conditioned behaviours incorporate several degrees of implicit learning, and the different conditioning phenomena are multifaceted (pp 135-136). Conditioning behaviours, however, are defined by the involvement of aversive (negative) or appetitive (positive) stimuli. In instrumental learning, the attention is shifted towards the (previously) rewarded cues, and in time, the rewarded ones acquire attentional priority (Anderson, 2016; Carder & Wood. 2018). In the case of music, this would mean that if one would put music on while doing the dishes, then they would prefer doing the dishes because of the reward of the music. Evaluative conditioning on the other hand, is defined by the change of the liking of one stimulus (conditioned stimulus), due to its pairing with another stimulus (which may be positive or negative) (Hofmann, De Houwer, Perugini, Bayens & Crombez, 2010). This would mean that if this was the case for music, one would start liking doing chores more just because it was paired with music (provided that they liked music). Evaluative and instrumental conditioning theories seem therefore not so applicable in the case of music.

As seen above, the other competitive learning phenomenon that could be applied in the situation of involuntary musical imagery is priming. Priming is defined as another category of learning, is a type of implicit memory, (Schwartz, 1989) and its function is improvement of identification of perceptual objects (Tulving and Schacter, 1990). Repetition of direct priming is the category of priming that is most relevant and antagonising to the hypothesis of this thesis, regarding music listening and involuntary musical imagery. In direct priming, the exposure to a stimulus (word, object or otherwise) enables its perceptual identification when related cues are provided (Ochner, Chiy, & Schacter, 1994; Schacter, Chiu & Ochner, 1993). However, this identification is an improved response, and more specifically a time-related improved response: the Stroop effect is a very common testing method for priming (MacLeod, 1991), in which the primed, automated association will improve (in terms of recognition-time) the responses of unrelated stimuli (Cohen, Dunbar & McClelland, 1990). Involuntary musical imagery does not seem to have that improvement effect, as Weir et al.'s (2015) findings suggest that individuals who reportedly have increased INMI do not perform better in the imagery tasks.

As all the above theories involve certain levels of learning, training, and unconscious processes, it is difficult to decipher exactly which one applies to this thesis' hypothesis. However, for the purposes of this thesis, I argue that the theory that applies the most is the one of classical conditioning, with the condition that one accepts music as a response eliciting function.

2.3.1 Involuntary Autobiographical Memories

Berntsen (2010) suggests that involuntary autobiographical memories may contribute to remembering, equally to voluntary memories, by sharing the same episodic memory system but differing on the ways of retrieval processing. In the past, involuntary pop-ups were considered as troublesome and/or happening as a post-traumatic stress symptom (Berntsen, 2002, 2009), and not a very frequent experience at that (Davachi & Dobbins, 2008). However, empirical studies have shown that the valence of involuntary autobiographical memories improves with age: older adults recalled more positive memories than their younger counterparts, and also rated the negative memories more positively (Schlagman et al., 2006). Research on mind-wandering suggests that there are several categories of involuntary thoughts: along with the involuntary autobiographical memories, discussed above, there are also the thoughts that occur without any trigger from the environment, and the stimulus-independent and task-unrelated thoughts (SITUTs; Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011). Evidence suggests that these thoughts are common and may have a role in helping the individual to anticipate and plan for the future (Stawarczyk et al., 2011).

2.4 INMI as episodic involuntary memory

As seen above, mind-wandering and involuntary autobiographical memories are common experiences and have a lot in common with INMI. Kvavilashvili and Mandler (2004) proposed that involuntary musical imagery is another manifestation of involuntary autobiographical memories, and the INMI literature often argues that INMI is an extension of that: Williamson and Müllensiefen (2012) discuss how the involuntary memory process may act as a trigger for INMI, in the form of several external and internal stimuli and cues.

Beaman et al., (2015) also consider INMI to be a form of involuntary autobiographical memory, and more specifically they propose that INMI may be linked to cognitive control: with higher mental control an individual is more able to suppress such memories (and INMI amongst them). In their study, they hypothesised that engaging one's voluntary processes and cognitive load would supress/reduce the duration of INMI episodes, and their findings showed that chewing gum appeared to reduce the number of INMI episodes, without however being able to decipher whether it also has the capability of reducing involuntary thoughts.

Indeed, involuntary memory research hits a similar vein to INMI and why some music comes back as INMI, while other music does not: this is a very similar question to why we are not flooded with autobiographical recollections. With regards to autobiographical involuntary memories, the ones that seem to come to mind are the ones that have created a strong link: personal events, specific meaning, or attention seem to signify the memories. This seems to be the case with INMI as well, as research so far (as discussed above) has not been able to find certain musical cues or characteristics that constitute a piece of music to be coming and returning as INMI (Müllensiefen, Fry, et al., 2014), nor a top INMI chart (Bailes, 2015; Jakubowski, Finkel, et al., 2016).

INMI is and acts the same way as autobiographical/episodic involuntary memories do: a recent study suggests that, indeed, involuntary musical memories rely on the same memory system (Jakubowski, Bashir, Farrugia, & Stewart, 2018), just as Berntsen (2010) proposes, with the exception of the retrieval process. Kvavilashvili and Mandler (2004) put forward the hypothesis that music, along with involuntary semantic memories, derives from a priming process through everyday experiences. I argue that, although involuntary musical imagery is indeed a type of memory that comes unbidden to mind, the reason it appears in one's mind is because the mind is trained into receiving the two stimuli together: music being one, and functions or activities of everyday life being the other. When one comes, the other will follow. The prevalence and occurrence rates of INMI will depend equally on the cues of episodic memory: 'Few things that we perceive make us think of previous happenings in our own lives… many stimuli that could potentially serve as reminders or cues, even if prominently displayed to a person, will have no such effect.' (Tulving, 1983, p. 169).

In other words, INMI is, at its core function, no different than episodic involuntary memories, but as everyday life is performed in the company/presence of music as systematically as our music listening habits dictate, an extra level of association process takes place, very similar to conditioning, and this link is what triggers INMI. Mace, Bernas, and Clevinger (2015) argued that non-experienced individuals would not be able to recognise the abstract cues (like thoughts or language) to their involuntary autobiographical memories, and therefore, were not able to report them—even though the cues would still trigger the involuntary autobiographical memories. They conducted a two-week diary study recording naturally occurring involuntary memories and their triggers in separate groups of graduate psychology students and students of other disciplines or first year undergraduates. Their findings showed that psychology students who were more experienced in recognising abstract cues did report more abstract cues than the other groups, whereas all groups reported equal sensory cues (such as, for example, visual cues or feeling pain) (Mace et al., 2015).

While the framework is probably the same for INMI and autobiographical involuntary memories (although neuroscience studies are needed to be sure), INMI appears to be different in one respect: while in autobiographical memories, one remembers themselves in a situation, place or otherwise, in INMI the phenomenon mainly contains the musical information. When someone has an earworm, it is more often than not, a melody or a fragment of that music that is 'stuck in their head' (Hyman et al., 2013; McCullough Campbell & Margulis, 2015), rather than the whole memory of listening to that piece (although that happens as well). This suggests that perhaps the music is being coded separately, which is explained by the theory of INMI being the conditioned response. Peretz and Zatorre (2005) argue that music, unlike speech, has not got a fixed semantic system, so it relies on information about form and structure, rather than meaning (as in language).

Indeed, there is evidence that individuals may be able to perceive and categorise musical form in more schematic ways (Snyder, 2000): listeners are able to detect musical (Lalitte & Bigand, 2006; Sloboda, 1985; Vallières, Tan, Caplin, & McAdams, 2009) and emotional (Tillmann & Bigand, 1996) function of short chunks of music, regardless of musical expertise. Music is being perceived as a whole, in terms of longer musical structures (Tillman & Bigand, 2004), but at the same time, it is the macro-structure of smaller segments (similar to how Schenkerian analysis dictates, Cadwallader & Gagné, 2007) that create the entity (Hanninen, 2012). These smaller segments (or otherwise called chunks) are governed by a hierarchy, by which certain events (chunks) are more important than others (Snyder, 2016, p. 173), and therefore may be the ones that constitute what the listener remembers. The theory above applies in music listening, but if perception of music functions according to this theory, then the chunks of music that seem to appear in one's head simply follow that structure. Musical imagery (and mental imagery in general) has many similarities with perception, in a sense that it acts as a 'medium for simulating perceptual properties of the external world.' (Kalakoski, 2001, p. 44), and that the general schemata forming in music perception are also being employed in musical imagery (Godøy & Jørgensen, 2001). This parallelism of perception and imagery, along with the chunking theories, seem then to explain why, for example, one has a certain chunk of music in their head, instead of another, and perhaps why it is certain chunks that seem to loop.

2.5 INMI as a conditioned response, a conclusion

From the above literature review, it is evident that many of the INMI attributes and behaviours are shared with the ones of music listening. The functions of music listening (why and how one listens to music, by choice or not), along with the affordances of music listening in terms of mood regulation that emerge in the music listening literature, are similar to the ones of the musical imagery. For example, music listening is found to be correlated with certain personality traits in individuals (Chamoro et al., 2010; Rentfrow et al., 2011), such as the openness to experience personality trait, which is correlated with using music in an intellectual way (Chamorro et al., 2010), and is also found to be a predictor for the frequency of musical imagery (Beaty et al., 2013). While there are no other studies investigating this direct link of music listening and musical imagery, the findings of the two domains (music listening and musical imagery) suggest that there may be a connection between them.

Similarly, as the literature on music listening shows specific functions of music listening (as accompaniment to activities, to regulate mood and emotions, to pass the time etc.), the literature on INMI shows equivalent factors and categories of INMI occurrences—for example, low attention states, found in Williamson et al. (2011) could be interpreted as being similar to wanting to listen to music to pass the time.

Thirdly, at its core experience, INMI is most often a repetitive, fragment of music (Williamson et al., 2011). At the same time, as seen in the literature review above, music by itself is also of a repetitive nature (from a musicological point of view, in terms of musical structure and composition, Bigant et al., 2005). On top of that, individuals replay and repeat the music that they like (Margulis, 2013), so the question that arises is to what extent repetition in music structure, memory and in music listening is somehow associated as a feature of music. Which leads to the next and final question: when taking into account the theories regarding priming and conditioning, with regards to music listening, to what extent do all these musical behaviours lead to a conditioning effect.

This thesis proposes the theory that INMI is the conditioned response from everyday music listening, based on the classical conditioning theory, as seen in Chapter 1. I suggest that people have music in their head due to previous exposure to music, combined with other situations in their life: that may be being places, activities, emotions, or any other daily circumstance that could coincide with music listening. This theory is directly addressing the classical conditioning theory—that a new by-product that is musical imagery is generated due to this association.

As seen above, several learning theories may be competing to the conditioning hypothesis. However, INMI comes in contrast to priming theories, where an improved response must be involved: the mental representation of a piece is not improved in those who often experience INMI (Weir et al., 2015), nor is there any other evidence that INMI comes with an improvement of any kind. On the other hand, one might argue that the process of conditioning through everyday music could also be explained as a process of evaluative conditioning, or operant conditioning. In the evaluative conditioning theory however, the key element is the depending relationship between the stimuli and the contingencies. In other words, one stimulus must depend from the other, which is often not the case with music listening: music is often just a musical carpet laid in the background.

Operant conditioning, on the other hand, according to Skinner's (1974) theory, suggests that the key element is that the intentional actions of an individual affect their environment. In more detail, the behaviour which is reinforced (rewarding) tends to be repeated, and it is the conscious actions of the individual that govern this behaviour. Indeed, in the case of music, one may listen to music to fill the void, or change the mood, or use as company. However, there is the argument that this action of putting music on, is not that changed: one's behaviour is not changed by the fact that they put music on, nor the goal is to have INMI.

Associations are a very big part of music listening, when one hears a song and is reminded of a situation (similarly to the Proustian madeleines). In the theory I am suggesting, having INMI transcends this act of association, as the mind actually 'creates' that experience. The experience is indeed triggered by an association, but the fact that it was involuntarily created, in my opinion, makes it fall under the conditioning umbrella.

Moreover, in operant conditioning it is the individual's conscious actions and the understanding of their consequences in interacting with their environment, that will develop the association. This could be applied to music listening, to an extent, as music listening has consequences, and mostly positive ones, as seen in the music listening section above: music has the affordances of improving the mood of the listener, creating an atmosphere etc. However, INMI is an involuntary phenomenon, and the associations with music listening which I propose, take place as unconscious and involuntary, without any further deliberation of the actions (by listening to music) and its consequences. Therefore, I propose that the classical conditioning theory better explains the phenomenon of having music in one's head.

The exact definition of the process is probably more nuanced than proclaiming that a simple classical conditioning process covers all music-listening-related behaviour; indeed, the process of INMI may incorporate features from other theories, such as secondary or evaluative conditioning, or be a form of associative or reinforcement learning, or even be a form of priming. This thesis aims to set the framework for opening up the possibility of research of INMI into a targeted relationship: that being one of INMI being associated with, and possibly generated from, music listening behaviour.

From the literature of INMI, above, I reviewed the different names, and possibly definitions/descriptions of the phenomenon that is having unsolicited music in one's head. The literature review illustrated that there is still a need for a robust definition of INMI, one that will explicitly include or exclude its characteristics, and that is widely embraced and used by researchers without ambiguity of its parameters. Moreover, several findings regarding the categories and circumstances in which INMI occurs still have not contributed to finding out why INMI happens. Taking together the theories of conditioning and associative learning presented above, I hope to contribute to finding the reason.

To conclude, INMI research is still ambivalent on what causes INMI: findings from past studies suggest that INMI correlates with certain personality traits (Floridou et al., 2012) and certain musical behaviours (Beaman & Williams, 2010). However, I argued that these correlations can be confounding evidence by the ways that people use music. I have discussed how studies from music listening in everyday life have shown that people have specific tastes and uses of music (North et al., 2004; Sloboda et al., 2001) that change throughout their lives (Groarke & Hogan, 2015; Saarikallio, 2011). Given the evaluation of the theories of classical conditioning (Mitchell et al., 2009), along with the overview of the music listening literature which suggest that music does elicit strong experiences and emotional responses (Gabrielsson & Bradbury, 2011; Menon & Levitin, 2005; Salimpoor et al., 2009), I propose that this systematic use of music can create an association similar to the conditioning process, and the conditioned response of this process is involuntary musical imagery.

3 Music, INMI and activities

3.1 Introduction

This chapter focuses on the investigation into music listening as an accompaniment to the activities of everyday life and how this could lead to INMI. According to the main hypothesis, if an activity is systematically being accompanied by music, then this systematic pairing will lead to an association which, in turn, may express itself as INMI in the absence of music. Moreover, if this music is consistently of the same genre, then INMI during this activity can also be expected to be of that genre. An experiment has been designed to test this hypothesis, which aimed to systematically combine music and activities in order to test whether INMI would appear after sufficient training.

As this design was novel, several considerations had to be taken into account and various methodological challenges arose. One of the first challenges was the type of music that would be used in the experiment: if the participants knew the musical piece, then their possible (pre-existing) associations would potentially affect the results. Positive or negative associations, or the possibility that the participants were already using this music in certain situations, would prohibit or hinder the new associations. Moreover, the INMI literature indicates that the general population (i.e. non-musicians) mainly have music with lyrics in their head (Bailes, 2006; Beaman & Williams, 2010; Liikkanen, 2011). However, lyrics might have led into extra-musical associations and again lead to mind-wandering, or to paying attention to the lyrics and their meaning instead of paying attention to the music of the experiment. The genre of the music that would be used was also a concern: an incongruent to the activity genre, without a clear melody and rhythm, would be particularly difficult to remember. (More details regarding the selection of the music appear in the Material sections of this chapter.)

The other main challenge was how to control for the effect of the experiment: the goal was to assess whether the pairing with music could create INMI. Controlling for the effect was necessary, for two reasons: first, INMI could happen regardless of the pairing of music and activities. Therefore, the most expected control would be performing an activity in silence. The silent (control) condition would also test the theory that derives from the INMI literature (Williamson et al., 2011), that recent and repeated exposure of a piece will lead to INMI of that piece later. If recent and repeated exposure is the main factor for experiencing INMI, then the INMI of the music that was used in the experiment would occur in every silent condition, including the silent training conditions and all the test conditions.

However, silence does not include any auditory information and one could argue that this does not ensure that it is the music which creates the associations and this pairing could also occur with other forms of auditory information aside from music. Therefore, another control block was considered that would include a podcast to account for simply associating the activity with the auditory information provided.

Another consideration of this design was how to adequately simulate the conditioning effect and how much repetition and training was enough to lead to conditioning. For this reason, there were two runs of this study (Study 1 and Study 2), with different training periods to assess whether more repetition would make any difference to the results.

The last consideration involved the type of the activities: as this design comprised one test block and two control blocks (meaning three different activities), the activities had to ensure similar engagement and skill: anything too difficult would potentially result in more focusing on the activity and not paying attention to music, anything too easy would result in losing interest and not paying attention to the task nor the music (and therefore the combination). Moreover, it should be something requiring a low level of pre-existing knowledge and/or skill, so it would ensure a homogeneity across the participants.

All the above considerations were taken into account, but some of them arose after the first run of this study. Therefore, a second study was designed to investigate whether adjusting some of the parameters would result in any differences. The aims and objectives for all studies are the same across the studies of this chapter, as they are all based on the same premise. As the methods changed slightly along the course of the studies, the methods, results, and discussions will be presented separately for each study, and then the chapter will be concluded with a general discussion.

3.1.1 Aims and objectives

The aim of this study was to test whether a systematic pairing of a particular sonic environment (music) with an activity leads to imagery of that sonic environment, after this association has been learned. This aimed to replicate the everyday life music listening situations, in which individuals often use specific music in specific situations, over a period of time. If this pairing leads to a training effect, and the training produces INMI, then this could potentially be replicated in the laboratory. The experimental design aimed to create this environment of pairing, through systematic exposure.

3.1.2 Prediction

The prediction was that the systematic pairing of music and activities would, after a period of training, lead to INMI, when the activity is performed in the absence of music.

3.2 Study 1

3.2.1 Method

As this hypothesis has never been tested before, a new experimental design was devised that would simulate the systematic pairing of a certain activity with music, versus one with no music. After a period of training, the activities would be performed without their pairing, to test the possibility of INMI. The test for INMI was done through questionnaires after every activity block.

The experimental design consisted of one test block, that would be an activity paired with music, and two control blocks. Participants were asked to repeat each set of three activities, three times, across two consecutive days, and then all activities were performed without their paired auditory environment (see Table 3.1).

3.2.1.1 Material

3.2.1.1.1 Acoustic material

It was decided to use music without lyrics as an attempt to eliminate an extra musical association, such as someone connecting to the lyrics of the song, or paying rather more attention to the lyrics than the music itself, or having an effect depending on the language skills of the participant. As seen above, this notion may be problematic as a premise, as the literature suggests (Bailes, 2009) that the majority of the population is having INMI of music with lyrics, and it is mainly musicians who experience orchestral music as INMI. However, it was important to investigate the effect of music, versus other acoustic environments, and therefore to implement this rule with the understanding of its potential limitations. Another restriction was that the piece had to have some characteristics that would make it easy to remember: namely, a concrete, monophonic melody that would be easily sung, and a simple structure (Dowling & Bartlett, 1981; Pauws, 2003; Weiss, Trehub, & Schellenberg, 2012).

Moreover, familiarity with a piece might lead to unwanted associations and take the focus out of the study. If a participant knew that piece, and associated it with other aspects of his or her life, that might hinder the newly-established association that this study attempted to implement. After bearing the above restrictions in mind, the music that was selected for this study was the instrumental intro from the piece 'Hang on little tomato' by Pink Martini—a light jazz piece.

The control conditions consisted of pairing activities, as discussed above, with a podcast and silence. The podcast was selected to have a general science theme, with no music playing, and no obvious references to music or words that may trigger INMI, to the knowledge of the researcher. The podcast was manipulated with the Audacity® (2014, v2.0.5) software, to have the same duration as the music track. Some parts of the podcast were excluded, and/or some extra pauses were added to ensure identical duration, without any of this being noticeable to the listener.

All condition blocks had to last the same time, to ensure the training effect would be the same across the conditions. Therefore, all conditions were timed and set to have the same time length at one minute and twenty-three seconds (1min23sec). The reasoning behind that specific timing was that the excerpt of music that was being used needed to have a closure, and not end abruptly. Therefore, as the piece came to a cadence at 1min23sec, right before the singing starts, it was decided to use that as the duration for all the other conditions.

The silence condition was also timed, and played as a silent track, with a beeping sound at the beginning and at the end of the track, to ensure the same timing, and so that the participant would know when to start and stop the activity.

All auditory tracks (music, podcast and the silent track with the start and finish sounds) were played to the QuickTime Player software for Mac, through speakers connected to an amplifier, connected to a Mac computer. The volume was kept the same during all the sessions.

3.2.1.1.2 Activities

There was an attempt to replicate situations that have been recorded as ‘music listening’ activities, such as house chores, leisure activities etc. (North et al., 2004). As this experiment was attempting to replicate everyday life activities, the design had several restrictions, as discussed in the introduction section of this chapter: first, all three activities had to be similar in engagement and accessibility. To ensure engagement to the activity, the chosen activity had to not require extra skill sets (such as knitting). Moreover, it had to be easily administrated in the lab; therefore, food preparation and exercising were excluded. Taking into account all the above restrictions, the three activities that were chosen were: sock pairing, (easy) puzzle solving and winding wool yarn into a ball.

All activities were set in three different areas within the room, and the participant had to stand up and move to the designated area for each activity. The reason behind that, was that it was prompting the participants to place emphasis on the differences between the activities and possibly assist them in registering the activities separately, rather than just seeing it as a whole block of experiments. The room set-up was kept the same for all sessions.

3.2.1.1.3 Questionnaires

Two questionnaires were used in this experimental design. One, that the participants had to fill in before the study, and which gathered information regarding the participants’ musical background and training, music listening habits and general INMI questions. The other questionnaire was the one used during the experiment, and after each condition, to assess the INMI of the participants. To conceal the purpose of this experiment from the participants, other questions were also included in this questionnaire, such as if they felt they had performed better, and questions regarding their mood.

Both questionnaires were built using existing questionnaires; the Earwormery questionnaire (Williamson et al., 2012) from Goldsmiths, the BARCELONA music reward questionnaire for music sophistication (Ernest, Josep, Urbano, J., & Antoni, 2013) and the Gold-MSI (Müllensiefen, Gingras, Musil, & Stewart, 2014), all with additional questions to serve our hypothesis purposes. The two questionnaires (background and tasks) were created using the Google Forms utility, and were accessed and completed online. (see Appendices A & B)

3.2.1.2 Procedure

During the training phase, each participant performed three different mundane activities (sorting socks, doing a simple puzzle and winding yarn balls) with three different auditory environments (music, podcast, and silence).

All activities and sonic environments were counterbalanced and randomised across participants: each participant had a different combination of activity and sonic environment. Additionally, the order of the presentation of the blocks was randomised across training sessions to eliminate order effects: each participant had a fixed pairing, but the order of performing the blocks was different.

Participants were asked to repeat each set of these three activities, three times, across two consecutive days. Finally, in the test session, all three activities were performed in silence. For a detailed example of the experiment see Table 3.1. The table is showing all the sessions of two participants, as an example: the combination of the activities remains the same across the sessions (for example music is always paired with yarn in Participant 1, as is silence with socks and podcast with puzzle), but the order of the activities is different to ensure that no order effect is affecting the results.

Table 3.1. Study 1, Procedure example

Participant 1	Day 1, 1st training	**Music + Yarn**	Silence + Socks	Podcast + Puzzle
	Day 1, 2nd training	Silence + Socks	**Music + Yarn**	Podcast + Puzzle
	Day 2, 3rd training	Podcast + Puzzle	Silence + Socks	**Music + Yarn**
	Day 2, test	**Yarn (no Music)**	Puzzle (no Podcast)	Socks (Silence)
Participant 2	Day 1, 1st training	Podcast + Socks	Silence + Yarn	**Music + Puzzle**
	Day 1, 2nd training	Silence + Yarn	Podcast + Socks	**Music + Puzzle**
	Day 2, 3rd training	**Music + Puzzle**	Podcast + Socks	Silence + Yarn
	Day 2, test	Socks (no Podcast)	**Puzzle (no Music)**	Yarn (Silence)

After each activity, the participant was asked to complete the short questionnaire as a baseline for the responses. The responses of the last set of activities, namely the test condition, revealed the results of this experiment, from the INMI-related questions.

The topic of this experiment has been concealed from the participants and they were led to believe that this study investigated performance in activities with or without music. Extra questions regarding the performance were added, to give emphasis on the performance instead of the musical imagery. This misguidance was used as a method to reduce, as much as possible, the levels of response bias, since the participants thought that the questions regarding their mood and the combination of activities and sound were the focus of the experiment.

The questions of the tasks are in detail in Appendix B, but the main questions included whether participants found the task difficult, if they enjoyed the task, their opinion of their performance, and if they thought that the combination helped and if they paid attention, and how familiar they were with the podcast and the music. Imagery wise, the participants were asked whether they had music in their head (related-unrelated to the experiment and during the task or during the questionnaire), if they had the podcast in their head, or any other thoughts during the experiment. Moreover, there was a question regarding their mood: what it was at the moment, and whether the experiment changed or enhanced it. (see Appendix B for more detail)

This study took place between November 2014 and February 2015. All sessions were performed in the same environment, keeping the set-up of the room, and the room itself, identical throughout the sessions.

Performing each block (and the completion of its questionnaire) lasted approximately 6–8 minutes if there were no interruptions in-between. Some participants did however choose to take some short breaks (a few minutes) between the conditions to have some refreshments, so the experiment in total took longer.

3.2.1.3 Participants

Thirty-one participants took part in this experiment. Some background information was obtained through a questionnaire, focusing on music listening, musicianship, and imagery experiences. No sociodemographic information (age, gender, nationality) was obtained in this study, as it was thought unrelated during the design of this experiment. This background information is presented in the results section of this chapter. Participants were recruited through the University of Sheffield's volunteer's list, and the study was advertised as a 'Music and everyday activities Experiment', describing the activities, but not mentioning anything about musical imagery.

3.2.1.4 Ethics

There were no foreseeable consequences of this experiment, except perhaps the (desirable) harmless association of the music of the experiment and the particular activity that the participant was performing with the music. This was expected to fade out without further repetition. This study has been ethically approved by the Ethics Committee of the Music Department at the University of Sheffield (No 002039, 03/11/2014). Participants gave their informed consent both in writing, at the beginning of the experiment, and electronically, in the first page of the background information questionnaire. All participants were aware that they could pause or stop the experiment at any time of their liking, without further explanation or consequences. All data were anonymised and the identity of the participants can only be retraced by the principal investigator, Ioanna Filippidi. Moreover, participants by giving their consent, had been informed and agreed that the collected data may be used for future publications and this thesis.

3.2.2 Results

3.2.2.1 Background results

Background information collected from the participants revealed that 22.6% of participants agreed or strongly agreed that they considered themselves musicians, 9.7 % somewhat agreed, 16.1 % neither agreed nor disagreed, 6.5 % somewhat disagreed and 45.2% disagreed or strongly disagreed ($N = 31$). Interestingly, 32.3% stated that they had engaged in regular daily practice for ten years or more, which is higher than the percentage from the self-assessment of musicianship related question.

The music listening reports varied, as was expected. The category that gathered the most assertions of this question was the one stating listening attentively to music for 30–60 minutes per day, with 35.5% of all answers. Table 3.2 provides all the scores of the reported music listening of the participants.

Table 3.2. Study 1, Time of music listening frequencies and percentages

I listen attentively to music for:		
	Frequency	Percent
4h or more	4	12.9
2–3h	2	6.5
2h	3	9.7
60'–90'	5	16.1
30'–60	11	35.5
15'–30'	4	12.9
0–15'	2	6.5
Total	31	100

Table 3.3, provides all the means, medians, and standard deviations of the responses to the background questionnaire.

Table 3.3. Study 1, Background information Means, Medians and Standard Deviation, *N*= 31

Questions	Valid N	Mean	Median	Std. Dev.
I listen attentively to music for: (1 0–15'; 2 15–30'; 3 30–60'; 4 60–90'; 5 2h; 6 2–3 h; 7 4h or more)	31	3.81	3	1.74
I spend a lot of my free time doing music related activities[1]	31	3.29	3	1.216
When I hear a tune I like a lot I can't help tapping or moving to its beat[1]	31	4.1	4	0.908
I often get emotional while listening to music[1]	31	4.61	5	1.726
Music calms and relaxes me[1]	31	5.55	6	1.312

On average I have music in my head: (1 less than 1 month; 2 once a month; 3 once a week; 4 once a day; 5 more than once a day)	31	4.23	4	0.956
The music in my head is always of my musical taste[1]	31	4.52	5	1.387
I mostly get annoying and repeated tunes in my head[1]	31	2.81	3	1.47
I often use music in my everyday life to motivate me[1]	31	5.55	6	1.48
I would consider myself a musician[1]	31	3.42	3	2.11
I usually have music playing in the background while doing other activities[1]	31	5.61	6	1.52
I would consider myself a positive person[1]	31	5.29	6	1.442
I mostly get fragments of music in my head[1]	31	4.55	4	1.786

[1]Rank Scale 1–7 (1 Strongly disagree – 7 strongly agree)

In terms of the uses of music among the participants, the most popular categories of music listening were; as an entertainment, and, combining music with activities, both with 74.2%, followed by using music for mood regulation (64.5%), to evoke emotions (61.3%), for socialising (54.8%) and other individual responses like dancing, inspiration or for 'living better' (2.9%, 1 response). The combination that gathered the most votes was the combination of all the above (mood regulation, entertainment, combining with activities, social, emotion evocation), of 32.3%.

Prevalence of musical imagery in this sample was high: 48.4% of participants retrospectively stated having music in their head more than once per day, followed by 35.5% having it once per week, 6.5% once a month and 9.7% once a month or more. None of the participants picked the option of having music in their head less than once per month.

3.2.2.2 Experiment results

The research question was whether INMI of the same music (henceforth referred to as Rel INMI) occurred in the Test condition of the activity that was previously paired with music (henceforth referred to as Music Test condition), as opposed to the other two Test conditions: The Podcast Test condition, and the Silent Test condition. Other considerations were Rel INMI, as opposed to unrelated-to-the-experiment INMI (henceforth referred to as Unrel INMI) that participants might have, and imagery of the podcast that was used in the experiment (henceforth referred to as INPod).

Data of the experimental questionnaire was not normally distributed, nor was there a good spread across the ordinal response categories. Consequently, non-parametric analytic tests were performed (Friedman and Wilcoxon signed ranks tests) and are reported in the following section, along with some of the Mean ranks of the responses. Moreover, one extra method for analysis seemed appropriate to categorise the data into 'yes' or 'no' responses, to perform further analytic tests, as responses were strongly polarised (either 1 or 7). Since the scale was unidirectional, from Not applicable (1) to Highly applicable (7), the mid-point (4) does not represent a neutral response, but rather a positive response (moderately applicable). The answers were, therefore, divided into two categories: reports of 3 and below were considered as a negative answer, and above 3 were considered as positive (see Appendices A & B for the questionnaires). These new categorised variables were analysed with non-parametric tests (Cochran's Q test) and used to compare the frequencies of the participants' responses.

3.2.2.2.1 Related INMI

Looking at the ratings of having related musical imagery (related to the music played during training) in the test conditions, the mean score was highest in the Music Test condition (M = 2.45, SD = 2.14, N = 31), followed by the Silent Test condition (M = 2.35, SD = 2.29) and the Podcast Test condition (*M* = 1.77, *SD* = 1.8). The difference between the Music and Silent Test conditions is very small.

Table 3.4 provides an overview of the tests between the different Test conditions, in terms of Rel INMI, Rel INPOD and Unrel INMI. A Friedman's test was used to examine if all three Test conditions were statistically different regarding Rel INMI, revealing that the effect was significant ($\chi 2(2) = 6.565$, $p = .038$). Post hoc Wilcoxon signed-rank tests showed no significance between the pairs of Test conditions, although the difference between Music and Podcast came closest to being significant (see Table 3.4).

Table 3.4. Study 1, Statistical difference between the Test conditions[1]

	Rel INMI	Rel INPod	Unrel INMI
All 3 Test Conditions	**$\chi^2(2) = 6.565$, $p = .038$***	$\chi^2(2) = 3.714$, $p = .156$	$\chi^2(2) = .800$, $p = .670$
Music Test VS Podcast Test	Z = -1.792, $p = .073$	Z = -1.656, $p = .098$	Z = -.179, $p = .858$
Music Test VS Silence Test	Z = -.307, $p = .759$	Z = .000, $p = 1.000$	Z = -476, $p = .634$
Podcast Test VS Silence Test	Z = -1.254, $p = .210$	Z = -957, $p = .339$	Z = -715, $p = .475$

Table 3.5, provides an overview of the comparison between the different variables (Rel INMI, Rel INPod, Unrel INMI) in the three different Test conditions. Rel INMI and Rel INPod were significantly different in the Music Test conditions and in the Silent Test condition, but not in the Podcast Test. Generally, Rel INMI was more strongly experienced than INPod. Interestingly, this difference disappeared in the Podcast condition.

[1] Non-parametric tests: Friedman (χ^2) and Wilcoxon signed-rank (Z). All significant tests are marked with *. $N = 31$.

Table 3.5. Study 1, Statistical difference between the Variables[2]

	Music Test	Podcast Test	Silence Test
Rel INMI VS Unrel INMI	Z = -1.123, p = .262	Z = -.311, p = .756	Z = -.120, p = .904
Rel INMI VS Rel INPod	**Z = -2.855, p = .004***	Z = -.893, p = .372	**Z = -2.539, p = .011***
Unrel INMI VS Rel INPod	**Z = -2.060, p = .039***	Z = -1.690, p = .091	**Z = -2.546, p = .011***
Rel INMI VS Rel INPod VS Unrel INMI	**$\chi^2(2)$ = 9.333, p = .009***	$\chi^2(2)$ = 1.476, p = .478	**$\chi^2(2)$ = 10.432, p = .005***

By using Cochran's test, in the categorised new variables, the effect failed to reach significance ($\chi2(2) = 5.400$, $p = .067$), although one of the pairwise comparisons was significant: more participants experienced Rel INMI in the Music Test condition than in the Podcast Test condition (Wilcoxon, Z = -2.121, p = .034). Moreover, the data categorisation provided a clearer illustration of the reports, as seen in Table 3.6. The responses were in the expected direction: in the condition that was coupled with music during training, relatively more participants responded positively to have imagined music during the test condition, than in the other two conditions. (see Table 3.6)

Table 3.6. Study 1, Number categorised reports of Rel INMI during the music, podcast and silent test conditions, *N*= 31

Condition	Negative response	Positive response
Music	21	10
Podcast	27	4
Silent	24	7

[2] Non-parametric tests: Friedman (χ^2) and Wilcoxon signed-rank (Z). All significant tests are marked with *. N = 31.

One problem with the training and testing of INMI is that participants could have had INMI during the training conditions, particularly when training was done in silence. To investigate this, Rel INMI in the Music Test condition was compared to Rel INMI in all the Silent conditions (training and test). A Friedman's test was used to explore such a difference, and the results were not statistically significant ($\chi 2(4) = 4.117$, $p = .390$). Similarly, the categorical variables showed no statistical difference (Cochran's Q: $\chi 2(4) = 5.787$, $p = .216$). However, as seen in Table 3.7, the Music Test condition received the most positive responses, whereas in the other conditions the positive responses varied.

Table 3.7. Study 1, Number of categorised responses of Rel INMI in all the Silence Conditions, and the Music Test, *N*= 31.

Condition	Negative response	Positive response
Silence 1	24	7
Silence 2	26	5
Silence 3	28	3
Silence Test	24	7
Music Test	21	10

3.2.2.2.2 Related Podcast

A Friedman's test was used to examine the effect of type of training on the imagery of the podcast related to the training (Rel INPod). This test showed that the effect was not significant (see Table 3.4 for an overview of the analysis). Using Cochran's test on the categorised responses, the effect was again shown to be insignificant ($\chi 2(2) = 3.500$, $p = .174$). The number of participants experiencing INPod was very low, although interestingly, more participants did respond positively in the podcast condition than in the other conditions (see Table 3.8).

Table 3.8. Study 1, Number of categorised responses of Rel INPod during the music, podcast and silent test condition, *N*= 31.

Condition	Negative response	Positive response
Music Test	31	0
Podcast Test	28	3
Silent Test	30	1

3.2.2.2.3 Unrelated INMI

Regarding INMI of unrelated music, Table 3.9 shows that a small number of participants had unrelated INMI—in particular in the Silence Training and Test conditions—but also a few across all conditions. For the Unrelated INMI, the difference between the three test conditions did not reach significance, either in the ordinal data analysis ($\chi2(2) = .80$, $p = .67$, $N = 31$) or after the responses were categorised (Cochran's q = .20, df = 2, $p = .91$, $N = 31$). The presence of Unrel INMI across conditions suggests that there might be a baseline of INMI, with people having it regardless of the acoustic environment. Lastly, a post hoc Wilcoxon signed-rank test showed no significant difference between the Rel INMI and the Unrel INMI in the Music Test condition, even though the number of people indicating Rel INMI (10) was twice as high as those indicating Unrel INMI (5) (see Table 3.4 & Table 3.5 for the correlations and Table 3.7 & Table 3.9 for the frequencies).

Table 3.9. Study 1, Number categorised reports of Unrel INMI during the music, podcast and silent test conditions, *N* = 31

Condition	Negative response	Positive response
Music Training 1	27	4
Podcast Training 1	30	1

Silence Training 1	26	5
Music Training 2	29	2
Podcast Training 2	28	3
Silence Training 2	27	4
Music Training 3	29	2
Podcast Training 3	27	4
Silence Training 3	23	8
Music Test	26	5
Podcast Test	25	6
Silent Test	25	6

3.2.2.2.4 Comments from comment boxes

Some participants (37.1%) reported having various thoughts throughout the experiment, which prompted several comments on the included 'open comment' boxes. The comment boxes revealed some level of distraction across the participants, as many reported thinking of previous experiences, what to eat or do after the experiment, their workload, of loved ones, or the casual conversations with the researcher. Many participants got competitive, as they thought that the point of the experiment was to perform faster on certain conditions (some thought that the music condition 'ought' to be the fastest). Some reported thinking about cats during the yarn condition, or doing puzzles with a loved one. Some participants also commented on how the tasks became easier to perform after the first repetitions, and how it became enjoyable. Further, some participants commented on how they thought that the song used in the experiment was the same as a song in a Pixar movie of 1995, Toy Story: 'You've Got a Friend In Me'.

3.2.3 Discussion

Overall, the results do not unambiguously support the hypothesis, yet there is a trend towards it: the Mean rating of Rel INMI during the Music Test task was higher than the ratings in the other conditions, but the main difference was with the Podcast condition, and less so with the Silence condition.

The three test conditions were significantly different regarding Rel INMI, which shows potentially an effect of the training. However, as seen in Table 3.4, the conditions, individually, were not significantly different. Furthermore, Rel INMI and Rel INPod were significantly different in the Music Test condition, but so were Unrel INMI and Rel INPod (see Table 3.5). Moreover, even though the reports of Rel INMI in the Music Test condition were twice the number of Unrel INMI (see Table 3.6 & Table 3.9), this difference failed to reach significance, indicating that the success of the manipulation is not certain.

Inconclusive findings also came from all the silent conditions, where the Rel INMI reports started high (see Table 3.7), declined as the sessions went on, and then were restored. However, as the report rates are very small, and there is no statistical difference between the conditions, there is no question of reliable conclusions.

Moreover, as seen in Table 3.9, the fact that there were reports of Unrel INMI, even in the Music or Podcast training conditions (where there was audio in the room), suggests that there may be a baseline of INMI to be expected in this type of experiment. The literature has shown high rates on the prevalence of INMI (Bailes, 2007; Liikkanen, 2008) and this finding was perhaps to be expected. Nonetheless, the rates of its occurrence may be worth further investigation, to determine the frequencies of INMI in the typical population, and whether a certain level of INMI is to be expected in experiments like this one.

Another surprising finding was the rates of INPod in the podcast condition, as seen in Table 3.8, suggesting INPod may indeed be a perceptual phenomenon, despite the small number. Perhaps in professionals, who use words like actors, poets, or writers, the scores would be higher.

The open comments indicate that there was a level of distraction which may have hindered the necessary attention to create an association: with such short training, the element of attention was very important, and even though there were no means of controlling it, having recorded the comments potentially underlines the difference of everyday situations. Moreover, other already-established associations with the tasks or the music might have had an effect. The attempt to find a piece of music that was not widely known aimed to address that, but surely some did know the song, or indeed thought they knew it by remembering another that reminded them of it.

There are various possible explanations for the weak results, which could be remedied with small alterations in the experimental design. The sample size was quite small for this kind of research project; a power analysis indicated that this study would require approximately 70 participants to have reliable results. The small number of volunteers was possibly due to the design of the study requiring two consecutive days. Even though the subjects could book their own appointments, the requirement that it had to be on two consecutive days probably discouraged some. Moreover, the training might not have been enough; indeed, the results from the pilot study, which lasted three days, were more encouraging. This may indicate that longer exposure to the activities over the course of several days may be responsible for the outcome. The above could be remedied by running a case study, with fewer participants, and more days of repetition to enhance training. A third consideration could be the choice of music: with a relatively short amount of training, the music should be something that is easy to remember and something that would be considered to be ‘catchy’. It is possible that the music that was used was not ‘catchy’ enough, and that with a different piece of music, the effect would be stronger.

3.3 Study 2

As reviewed in the Discussion section of Study 1, above, the results were inconclusive, albeit promising. Therefore, it was decided to repeat the study, with some of the modifications mentioned in the Discussion section above.

The hypothesis and the idea behind this second study are exactly the same as the previous round of this study. However, some elements were changed, taking into account the following considerations: firstly, the music that was used might not have been appropriate for such an association. Secondly, the amount of training might not have been enough to create such an association in such a short time. Thirdly, some other factors such as age, gender etc. might have played a role in who experiences INMI.

The above considerations were taken into account, and were addressed accordingly: firstly, to address the issue of the music, a new survey was devised in which participants voted how ‘catchy’ a piece was (further explanation on that below, in the acoustic material section). The factor of the training was addressed through a modification of the amount of training and the number of days that the participants were training. In the new design, there were three days of experiments, with two sessions each, so eighteen blocks of experiments in total: fifteen training and three test trials. Lastly, a new background information questionnaire was created, which served a double purpose of pre-screening for the mood regulation study as well. This questionnaire included sociodemographic information questions, and questions providing a more in-depth approach to the music listening habits of the participants, which would allow for further explorations of different possibilities and correlations, such as educational background, age etc. with the occurrence of INMI.

3.3.1 Method

3.3.1.1 Material

3.3.1.1.1 Acoustic material

3.3.1.1.1.1 Assessment of catchiness of music through online questionnaire

As discussed above, there were several criteria that had to be met when choosing the music: the music had to have no lyrics, yet have a distinct melody that would be easy to sing and a simple structure that would be easy to remember. As the training procedure is shorter than possible in real-life situations, and the music unfamiliar, it was essential to take some precautions regarding the type of the music that was used. To ensure that the melody that was used was easy to remember with little training, it was decided to use a 'catchy' piece, that would be more likely to 'stick in the head' of the participants, even with little training.

To assess catchiness, a questionnaire was created in which individuals rated catchiness, likeability, and familiarity. A set of pieces was selected that met the criteria discussed above: several pieces of jazz songs and some folk songs. The term 'catchy' was not fully explained in those questionnaires, as most people have an intuitive idea of what catchiness is, even if they are not sure of the specifics, and this was an attempt to assess this intuition. This survey was completed by 174 participants.

All pieces were blindly rated, as the rating was through a YouTube link incorporated in a Google Form. All pieces were edited, so that there were no lyrics and the rated excerpts were the sections that would be used in the experiment. All excerpts were directly uploaded to YouTube with the same image as a background. The rating questions were presented after each YouTube link, on a Likert scale from 1 to 5, not catchy to very catchy.

Results from the poll showed that the piece determined as the catchiest that was used in the pilot of this study was the 'Gay Gordons' Scottish dance by Jim Cameron Scottish

Band (See Table 3.10 for scores). The mean of the Gay Gordons ratings was 3.4 (SD = 1.2, N = 174), higher than any of the other seven pieces rated, with 36% agreeing or strongly agreeing about its catchiness—although not significantly catchier than the next in rank ('So what' with 31.8% rates; Z = -1.21, p = .23). A Wilcoxon signed-ranks test was performed between the highest ranked piece on catchiness ('Gay Gordons') and the piece that was used in Study 1 (Hang on little tomato, Pink Martini), which showed that the 'Gay Gordons' was significantly higher in the catchiness ranks than the Pink Martini piece (Z = -2.49, $p < .01$, N = 174).

Table 3.10. Study 2, Assessment of Catchiness, Likeness, Familiarity in aggregated percentages of the statements Agree and Strongly Agree, *N* = 174

Piece with order of Presentation	Catchiness %	Know it %	Like it %
Blue Monk, Thelonious Monk	34.4	9.2	28.2
Visa från Utanmyra, Jan Johansson	17.3	2.9	33.3
A Sentimental Journey, Doris Day	39.6	16.3	40.8
Blue train, John Coltrane	40.3	10.9	28.1
Hang on little tomato, Pink Martini	43.1	**20.7**	**47.1**
So what, Miles Davies	47.8	10.3	10.8
Gay Gordons, Jim Cameron Scottish Band	**54**	8	28.1

Interestingly, the Pink Martini piece that was used in the previous study was rated as the most liked piece, with Mean 3.32 (SD = 1.1, N = 174), as well as being the most familiar, albeit to a smaller degree, with Mean 2.32 (SD = 1.1, N = 174).

3.3.1.1.1.2 Audio manipulation

The duration of the entire piece is 2 minutes 37 seconds, and, similarly to Study 1 presented above, the podcast and silence tracks needed to match that timing. A different podcast was selected for this round, one that matched the timing of the new music. As per the previous study, the podcast had to have no music in it, and no apparent links to music or words that triggered music, to the best of the researcher's knowledge. The podcast that was found to meet these criteria was a Ted talk, on how to create new habits in a month. Again, significant effort was made to find an interesting podcast, as the participants would have to listen to it several times, and there would be a risk of losing interest after the first time and not pay further attention to it. Music, by default, did not run this risk so much, as people often put music on repeat, without losing the sense of meaning, or losing interest in it (Honing, 2011; Margulis, 2014). The podcast again needed some editing, so that it would be the same time length as the music at 2 minutes 37 seconds, by editing out some passages of audience laughter and some extra narrative that did not affect the storytelling of the podcast.

Similarly, a new silent track was created of 2 minutes 37 seconds, with a beeping sound to signal the beginning and the end of the trial. As with the first study, the audio tracks were manipulated to have the same time length and volume using the software Audacity® (2014, v2.0.5).

3.3.1.1.2 Activities

The activities were the same as the first round of the experiment, as the point was to investigate the effect of new music and further training. There was no indication to suspect that the performed activities needed changing.

3.3.1.1.3 Questionnaires

A new pre-screening questionnaire was devised, that also accounted for sociodemographic information, and included questions that provided a more in-depth approach to the music listening habits of the participants. The questionnaire that was used to assess INMI during the experiment (Tasks questionnaire) was kept the same as in Study 1.

3.3.1.1.4 Procedure

As the new experimental design aimed to address the factor of insufficient repetition for the training effect to be implemented, it was decided to add an extra day to the study, with five sets of trainings instead of the three undertaken in the previous study. See Table 3.11 for an example of the procedure. Similar to Study 1, the example below comprises the experimental layout of two hypothetical participants: each participant has a constant combination/pairing of the activities and sonic environment (for example, in the 1st participant, this combination is always socks and music, yarn and podcast, and puzzle and silence), but the order of the presentation changes, in order to limit any order effects.

Table 3.11. Study 2, Procedure example

Participant 1	Day 1, 1st training	Puzzle + Silence	**Socks + Music**	Yarn + Podcast
	Day 1, 2nd training	**Socks + Music**	Puzzle + Silence	Yarn + Podcast
	Day 2, 3rd training	Yarn+ Podcast	**Socks + Music**	Puzzle + Silence
	Day 2, 4th training	Puzzle + Silence	**Socks + Music**	Yarn + Podcast
	Day 3, 5th training	**Socks + Music**	Yarn + Podcast	Puzzle + Silence
	Day 3, 6th test	Yarn (no Podcast)	**Socks (no Music)**	Puzzle (Silence)

Participant 2	Day 1, 1st training	**Yarn + Music**	Socks + Silence	Puzzle + Podcast
	Day 1, 2nd training	**Yarn + Music**	Puzzle + Podcast	Socks + Silence
	Day 2, 3rd training	Socks + Silence	**Yarn + Music**	Puzzle + Podcast
	Day 2, 4th training	Puzzle + Podcast	**Yarn + Music**	Socks + Silence
	Day 3, 5th training	Socks + Silence	Puzzle + Podcast	**Yarn + Music**
	Day 3, 6th test	**Yarn (no Music)**	Puzzle (no Podcast)	Socks (Silence)

As with Study 1, the combinations of the activities and auditory information were counterbalanced across participants, as was the order of the training sessions. The setup of the room was also kept the same as in Study 1. Participants were again given the impression that this study investigated how well they performed in the activities. Since the new background questionnaire had more in-depth questions on the music listening habits of the participants, some participants also thought that this study might have been investigating whether their music listening habits affected their performance in the activities. Participants were again left to believe this during the study, without confirming or denying it, but there was a de-briefing session after the study in which the purpose of the experiment was revealed.

3.3.1.1.5 Participants

Fifteen participants completed the study, eight females and seven males. Nine participants were native English speakers. Five participants were undergraduates, nine were postgraduates, and there was one A-level student.

3.3.1.1.6 Ethics

This study entailed the same ethical considerations as Study 1, therefore, Study 2 did not require extra amendments. As such, Study 2 was treated as complementary to Study 1 in terms of ethics approval. This study took place between November 2016 and June 2017.

3.3.2 Results

3.3.2.1 Background results

The main categories of the background questionnaire's results (musicianship, music listening, uses of music, and INMI), as well as the ones that yielded a strong polarity on agreement or disagreement, will be reported here, and the rest of the background results are reported in relation to the experimental results. Two participants identified themselves as musicians and had studied music for more than seven years. A further ten participants had played an instrument at some point in their lives at various levels of proficiency.

3.3.2.1.1 Music listening

Music listening responses varied, with the 2–3 hours per day option collecting the most answers (40%), followed by a tie between 60–90 minutes and 4 hours or more (20% each). The use of music that gathered the most individual responses was using music to change or enhance their mood, with 93.3% opting for this, followed by using music for entertainment and for accompanying activities (each with 80%). Next was using music to evoke emotions with 73.3%, and using music for social reasons with 53.3%. The 'other' option was only chosen by one participant, stating that they use music to 'work in a specific rhythm'. 40% of participants opted for all options: they used music to change or enhance their mood, for entertainment, accompanying activities, for social reasons, and to evoke emotions. Table 3.12, illustrates the Mean and Median scores across participants in the rest of the background questions, to further demonstrate the variation in the uses of music across participants.

Table 3.12. Study 2, Means, Medians and Standard Deviations of Music listening

Questions	N	Mean	Median	Std. Dev.
I listen to music to make cleaning and other housework more pleasant	15	4.6	5	0.507
I usually put background music on to make the atmosphere more pleasant	15	4.27	5	1.1
I usually listen to music as a background, while doing other activities	15	4.4	5	0.91
When I'm going out (for example for classes, hobbies, or a party), I listen to music to get myself in the right mood	15	3.8	4	1.32
When I'm tired out, I rest by listening to music	15	4	4	1.134
Listening to music doesn't help me to relax	15	1.87	2	0.99
I mostly use music to relax and unwind	15	3.6	4	1.183
When I'm exhausted, I listen to music to perk up	15	3.73	4	1.335
I listen to music to get a breathing space in the middle of a busy day	15	3.93	4	0.884
When I'm feeling sad, I listen to music	15	4.33	4	0.724
Listening to music helps me to relax	15	4.07	4	0.704
Music does not evoke strong emotional experiences in me	15	1.67	1	1.234
I like to listen to music that evokes feelings in me	15	4.33	4	0.724
When I feel bad, I try to get myself in a better mood by engaging in some music-related activity	15	3.93	4	0.799
I can't push my worries aside with the help of music	15	2.47	2	1.302
When everything feels miserable, I start to listen to music that expresses these feelings	15	3.33	3	1.047
When everything feels bad, it helps me to listen to music that expresses my bad feelings	15	3.47	4	1.187
When I get angry, I give vent to my anger by listening to music that expresses my anger	15	3.27	4	1.624
Listening to music takes me back and gets me thinking about different things that have happened to me	15	4.13	5	1.246
When I'm really happy, I feel like listening to some happy music	15	4.33	5	0.976
When I'm really sad, I feel like listening to some sad music	15	3.2	3	1.146
Listening to music doesn't comfort me in my sorrows	15	1.67	2	0.617
I mostly listen to music when I'm doing physical activities such as exercise, walking, or cycling	15	3.27	4	1.1
I mostly listen to music when I'm doing engaging mental activities such as reading or writing	15	2.87	3	1.457
I mostly listen to music when I'm doing routine activities such as housework, cleaning, or brushing my teeth	15	3.47	4	1.187
In a stressful situation I listen to music to relax	15	3.8	4	0.862
I have very specific musical tastes	15	3.53	3	1.125
I listen to different music in different situations	15	4.2	4	0.862
I don't really care what I'm listening to, it's usually in the background	15	1.6	1	0.737

3.3.2.1.2 INMI

The majority of participants agreed (20%) or strongly agreed (53.3%) on often having music in their head, while 13.3% (2 participants) neither agreed nor disagreed, and 6.7% (1 participant) disagreed, and 6.7% strongly disagreed. Moreover, a majority also agreed (53.3%) or strongly agreed (26.7%) that the music in their head is mostly of their musical taste, with 13.3% neither agreeing nor disagreeing, 6.7% disagreeing and no reports of strongly disagreeing. Table 3.13 is providing the means and medians of all the INMI reports.

Table 3.13. Study 2, Means and Medians of INMI background reports

Questions	N	Mean	Median	Std. Dev.
I often have music in my head (earworms)	15	4.07	5	1.28
My earworms are mostly of my musical taste	15	4	4	0.845
I get the same earworm coming back again and again	15	3.27	3	1.033
I find it difficult to get rid of my earworms	15	2.67	2	1.234
Earworms help me when I'm trying to get things done	15	2.53	3	1.246
It worries me when I have an earworm stuck in my head	15	1.93	2	1.033
I find my earworms irritating	15	2.27	2	1.223
I am usually unaware of what caused my earworms	15	3.07	3	1.534
I try to work out what might have triggered my earworms	15	3.4	4	1.056
Hearing music triggers my earworms	15	3.13	3	1.125
Personal issues trigger my earworms	15	2.8	3	1.373
My earworms are triggered when I think about past events	15	3	3	1.195
My earworms bring back past emotional associations	15	3	3	1.195
I get earworms when I'm doing physical activities such as exercise, walking, or cycling	15	2.87	3	1.552
I get earworms when I'm doing engaging mental activities such as reading or writing	15	3	4	1.512
I get earworms when I'm doing routine activities such as housework, cleaning, or brushing my teeth	15	3.8	4	1.265
Words that I hear or read trigger my earworms	15	3.33	4	1.345
My earworms don't necessarily match my mood	15	3.53	4	1.246
My earworms are not as vivid as hearing real music	15	4	4	1
I don't like the music I have as earworms	15	2.13	2	0.743
I like my earworms	15	3.27	4	1.28
When I get an earworm I try to manipulate it in my head	15	3.47	4	1.642
When I get an earworm I mention it to other people around me	15	2.93	3	1.438
My earworms contain music that I have never heard before	15	2	2	1.363
The earworms I get are from styles of music to which I would not normally choose to listen	15	2.47	2	0.834
My reaction to an earworm is to listen to/ sing/ hum/play the imagined music	15	4	4	1.195
In my life, there have been times when I've had earworms more frequently and times when they were less frequent	15	3.8	4	1.014
I enjoy earworms as much as listening to actual music	15	2	2	1.069
I get earworms when I would like to listen to music	15	3.47	3	1.356

3.3.2.2 Experiment results

Similar to Study 1, the target of the study was to examine whether the systematic pairing of a sonic environment would lead to associations which, in turn, would express themselves into INMI of the same kind. Therefore, the investigation of related INMI (Rel INMI) to the experiment, during the Music Test condition (the silent test version of the condition that was previously paired with music), as opposed to Podcast Test and Silence Test, is one of the main questions.

Data was once again not normally distributed; some non-parametric analytic tests (such as Friedman's and Wilcoxon signed ranks) were performed. Then, the variables in question were again categorised into 'yes' for answers of 3 and above, or 'no' for answers below 3. (see more details in Experiment Results of Study 1, earlier in this chapter)

3.3.2.2.1 Related INMI

The Mean of the Rel INMI for the Music Test condition was the highest (M = 3.2, *SD* = 2.60, *N* = 15, Minimum = 1, Maximum = 7), followed by the Silence Test (M = 2.7, *SD* = 2.61) and last, the Podcast Test (M = 2.5, *SD* = 2.41, *N* = 15). The Music Test condition also had the highest mean of all the silent conditions (training and test) (see Table 3.14).

Table 3.14. Study 2, Mean scores of Rel INMI in Silence (Training and Test) and Music Test conditions. *N* = 15

Conditions	N	Mean	Std. Deviation
Silence Training 1	15	1.867	1.8074
Silence Training 2	15	1.467	1.5523
Silence Training 3	15	1.467	1.0601
Silence Training 4	15	2.067	2.0517
Silence Test	15	2.667	2.6095
Music Test	15	3.2	2.5967

The Rel INMI in the three test conditions was not significantly different according to Friedman's test (see Table 3.15), nor were their categorised counterparts reliably different

(Cochran's Q: χ2(2) = 1.600, p = .449). Pair-wise Wilcoxon tests also showed no significant different of Rel INMI between the three Test conditions (see Table 3.15).

Table 3.15. Study 2, Statistical difference between the Test conditions, *N* = 15

	Rel INMI	Rel INPod	Unrel INMI
Music Test VS Podcast Test	Z = -1.105, p = .269	Z = .000, p = 1.000	Z = -.271, p = .786
Music Test VS Silence Test	Z = -.863, p = .388	Z = -1.000, p = .317	Z = -.316, p = .752
Podcast Test VS Silence Test	Z = -.365, p = .715	Z = -1.000, p = .317	Z = -.105, p = .916
All 3 Test Conditions	$\chi^2(2) = 2.083$, p = .353	$\chi^2(2) = 2.000$, p = .368	$\chi^2(2) = .560$, p = .756

Non-parametric tests: Friedman (χ^2) and Wilcoxon signed-rank (Z). All significant tests are marked with *.

Table 3.16, shows the difference between the variables in the different conditions. Rel INMI is significantly greater than Rel INPod in the Music Test condition, and also in the Podcast Test condition. In the Silence Test condition, Unrel INMI is significantly larger than Rel INPod, whereas Rel INMI is not.

Table 3.16. Study 2, Statistical difference between the Variables, *N*=15

	Music Test	Podcast Test	Silence Test
Rel INMI VS Unrel INMI	Z= -.778, p=.437	Z= -.070, p=.944	Z= -.086, p=.931
Rel INMI VS Rel INPod	**Z= -2.388, p=0.17***	**Z= -2.032, p=.042***	Z= -1.701, p=.089
Unrel INMI VS Rel INPod	Z= -1.890, p=0.59	**Z= -2.207, p=.027***	**Z= -2.032, p=.042***
Rel INMI VS Rel INPod VS Unrel INMI	**$\chi^2(2)$= 7.655, p=.022***	**$\chi^2(2)$= 6.889, p=.032***	$\chi^2(2)$= 4.692, p=.096

Non-parametric tests: Friedman (χ^2) and Wilcoxon signed-rank (Z). All significant tests are marked with *.

However, the positive (categorised) responses are slightly higher in the Music Test condition than in the others (see Table 3.17).

Table 3.17. Study 2, Number of categorised reports of Rel INMI in the three Test conditions, *N* = 15

Condition	Negative response	Positive response
Music	8	7
Podcast	10	5
Silent	10	5

Similarly, the Rel INMI scores of the categorised responses for the Music Test condition were higher than all the Silence conditions (training and test, see Table 3.18), and Cochran's Q test showed that they were statistically different ($\chi 2(6) = 14.093$, $p = .029$).

Table 3.18. Study 2, Number of categorised responses of Rel INMI in all the Silence Conditions, and the Music Test, *N* = 15

Condition	Negative response	Positive response
Silence 1	12	3
Silence 2	14	1
Silence 3	14	1
Silence 4	13	2
Silence 5	12	3
Silence Test	10	5
Music Test	8	7

3.3.2.2.2 Related Podcast

As seen in Table 3.19, no Rel INPod was reported in this round for the Podcast or Music conditions, and there was only one report for the Silent condition.

Table 3.19. Study 2, Number of categorised responses of related podcast imagery during the music, podcast and silent test condition, *N* = 15.

Condition	Negative response	Positive response
Music	15	0
Podcast	15	0
Silent	14	1

3.3.2.2.3 Unrelated INMI

The Mean of the Unrel INMI for the Music Test condition was $M = 2.45$, $SD = 2.41$, in the Podcast Test condition, $M = 2.533$, $SD = 2.33$, and in the Silence Test condition $M = 2.60$, $SD = 2.50$. The difference between the Rel INMI and the Unrel INMI in the Music Test condition's categorical variable was not significant (see Table 3.16).

Table 3.20. Study 2, Number of categorised reports of Unrel INMI during the music, podcast and silent test conditions, *N* = 15

Condition	Negative response	Positive response
Music Training 1	15	0
Podcast Training 1	11	4
Silence Training 1	11	4
Music Training 2	15	0
Podcast Training 2	12	3
Silence Training 2	13	2
Music Training 3	14	1
Podcast Training 3	13	2
Silence Training 3	11	4
Music Training 4	14	1
Podcast Training 4	15	0
Silence Training 4	12	3
Music Training 5	14	1
Podcast Training 5	12	3
Silence Training 5	12	3
Music Test	11	4
Podcast Test	10	5
Silent Test	10	5

3.3.2.2.4 Comments

Analogously to Study 1, there were several open comments indicating the level of distraction and other thoughts that occurred during the experiment. Participants reported wanting to change the music, or made comments on how it changed from annoying to helpful and vice-versa, across sessions. Others reported getting competitive on the tasks, or made plans for the day, or simply thought about the podcast, or the conversation they had with the researcher.

3.3.3 Discussion

Overall, the results of Study 2 are inconclusive, similar to Study 1. However, the reported Rel INMI for this study has a higher mean than Study 1 (see Table 3.14), which could mean that the modification of the experiment did work, but as the three test conditions are not significantly different, this could be by chance (see Table 3.15). Moreover, there was no significance between Rel and Unrel INMI in any of the test conditions (see Table 3.16), which underlines the uncertainty of the manipulation, which is complicated by the smaller number of participants in this second study.

The analysis showed no significance between Rel INMI and Rel INPod in the Silent condition, whereas it did show significant difference between Unrel INMI and Rel INPod, which potentially means that Unrel INMI was occurring more in the Silent condition. In contrast to Study 1, there was no reported INPod on the Podcast Test condition, and there was only one report for the Silence Test condition.

The second study addressed the issue of the amount of training, but not the issue of number of participants. Participants were recruited from November 2016 until June 2017, with only fifteen participants in total. Undoubtedly, this study required a certain amount of commitment from the participants, asking to come to the lab on three consecutive days, and, as there was no possibility of monetary compensation, this has possibly deterred individuals from participating.

Therefore, one of the limitations of this study may be traced to the small (and smaller than Study 1) number of participants, which may hinder significant statistical analysis. The frequencies may indicate a trend towards the hypothesis, but as they are not strong enough to suggest significance, no claims can be made.

Another possible implication may be the music that was used: the Scottish song that was used in this experiment scored higher in terms of catchiness, but not in likeability or familiarity. As this experiment relies on involuntary association, attention over listening is potentially crucial. If the participants did not like the piece, they might have 'blocked' it out, and therefore not paid too much attention to it. Byron and Fowles (2013) argue that familiarity does relate to INMI, so, if the participants were more familiar with the music, perhaps the association would be stronger. Additionally, control may also play a role in the training: choice and liking correlate with the pleasantness of a musical experience (Krause et al., 2013), and, as such, it would be worth investigating in the future if that would also have a role in INMI experiences.

3.4 Combination of Study 1 & Study 2

Both the above studies have investigated the phenomenon of eliciting INMI through a process of conditions, with repeated training in different conditions. Since the two procedures were very similar, and the obtained measurements (the questionnaires) were identical, the possibility of merging the two datasets and testing the statistical significance of a bigger pool of participants could potentially yield different results. Thus, with the strong limitation in mind that the two studies were not entirely identical (that is, Study 2 had 3 days of training and consequently more training sessions, and also had different music and podcast), but similar enough to be able to be taken together, the section below presents some extra statistical analyses that were performed on the combined datasets of Studies 1 & 2.

3.4.1 Results

The two datasets combined have a larger pool of participants (N=46), which provides a stronger statistical power. Friedman and Wilcoxon non-parametric were used, as earlier, to examine the effect of the Test condition: in this combined data-set, Rel INMI is significantly different in the three Test conditions and significantly different between the Music and Podcast condition (see Table 3.21). Rel INMI was not significantly different in the Podcast vs Silence Test, nor in the Music vs Silent Test.

Table 3.21. Studies 1 & 2, Statistical difference between the Test conditions, N = 46

	Rel INMI	Rel INPod	Unrel INMI
Music Test VS Podcast Test	**Z = -2.016, p = .044***	Z = -1.656, p = .098	Z = -.379, p = .705
Music Test VS Silence Test	Z = -.780, p = .435	Z = -.743, p = .458	Z = -.715, p = .475
Podcast Test VS Silence Test	Z = -1.369, p = .171	Z = -.171, p = .864	Z = -.400, p = .689
All 3 Test Conditions	**$\chi^2(2)$ = 7.743, p = .021***	$\chi^2(2)$ = 2.25, p = .325	$\chi^2(2)$ = .831, p = .66

Furthermore, in the Music Test condition, Rel INMI, Rel INPod and Unrel INMI were significantly different to each other (see Table 3.22). A two-related-samples Wilcoxon test showed that Rel INMI is different from Rel INPod in the Music Test condition, and so is Unrel INMI. Similar significant results were found for Rel INMI vs Rel INPod and Unrel INMI vs Rel INPod for the Podcast and Silent Test conditions. In all instances, the experience of INMI (related or unrelated) was stronger than the experience of INPod.

Table 3.22. Studies 1 & 2, Statistical difference between the Variables, N = 46

	Music Test	Podcast Test	Silence Test
Rel INMI VS Unrel INMI	Z = -1.257, p = .209	Z = -.352, p = .725	Z = -.105, p = .916
Rel INMI VS Rel INPod	**Z = -3.702, p < .001***	**Z = -2.205, p = .027***	**Z = -2.921, p = .003***
Unrel INMI VS Rel INPod	**Z = -2.754, p = .006***	**Z = -2.673, p = .008***	**Z = -3.203, p = .001***
Rel INMI VS Rel INPod VS Unrel INMI	**$\chi^2(2)$ = 16.930, p < .001***	$\chi^2(2)$ = 5.681, p = .058	**$\chi^2(2)$ = 14.952, p = .001***

As an extra step of analysis, imagery was examined in its respective conditions: Related or Unrelated INMI for the Music Test condition compared to Related INPod for the Podcast Test condition. A Wilcoxon two-related-samples test showed that Rel INMI in the Music Test condition was significantly different from Rel INPod in the Podcast Test condition (Z = -3.525, $p < .001$) and so was Unrel INMI in the Music Test, as opposed to Rel INPod in Podcast Test condition (Z = -2.523, $p = .012$).

The responses were categorised in the same way that was described above in the Results section of Study 1, to examine the trend across individuals. Table 3.23, Table 3.24 and Table 3.25 provide the frequencies of the responses in the three test conditions of Rel INMI, Rel INPod, and Unrel INMI, respectively. The number of positive responses for Rel and Unrel INMI were similar for the Podcast and Silence conditions, as was the Unrel INMI in the Music condition (between 9 and 12). The number of positive responses for Rel INMI in the Music Test condition was higher (N=17).

Table 3.23. Studies 1 & 2, Number of categorised reports of Rel INMI during the music, podcast and silent test conditions, *N* = 46

Condition	Negative response	Positive response
Music	29	17
Podcast	37	9
Silent	34	12

Table 3.24. Studies 1 & 2, Number of categorised responses of Rel INPod during the music, podcast and silent test condition, *N* = 46.

Condition	Negative response	Positive response
Music	46	0
Podcast	43	3
Silent	44	2

Table 3.25. Studies 1 & 2, Number categorised reports of Unrel INMI during the music, podcast and silent test conditions, *N* = 46

Condition	Negative response	Positive response
Music Test	37	9
Podcast Test	35	11
Silent Test	35	11

Analysis of the categorical data of the combined studies confirmed a statistically significant difference in Rel INMI between the three Test conditions, with the Music Test, in particular, being different from the Podcast conditions (see Table 3.26).

Table 3.26. Studies 1 & 2, Statistical difference between the Test conditions, Categorical data, *N* = 46

	Rel INMI	Rel INPod	Unrel INMI
Music Test VS Podcast Test	**Z = -2.309, *p* = .021***	Z = -1.732, *p* = .083	Z = -.632, *p* = .527
Music Test VS Silence Test	Z = -1.667, *p* = .096	Z = -1.414, *p* = .157	Z = -.577, *p* = .564
Podcast Test VS Silence Test	Z = -1.000, *p* = .317	Z = -.447, *p* = .655	Z = -.000, *p* = 1
All 3 Test conditions	**χ^2(2) = 6.533, *p* = .038***	χ^2(2) = 2.800, *p* = .247	χ^2(2) = .500, *p* = .779

Rel INMI was shown to be statistically different from Unrel INMI in the Music Test condition, but not in the Podcast or Silence Test conditions (see Table 3.27). Unrel INMI was also different from Rel INPod in all 3 Test conditions.

Table 3.27. Studies 1 & 2, Statistical difference between the Variables, Categorical data, *N* = 46

	Music Test	Podcast Test	Silence Test
Rel INMI VS Unrel INMI	**Z = -2.000, *p* = .046***	Z = -.535, *p* = .593	Z = -.258, *p* = .796
Rel INMI VS Rel INPod	**Z = -4.123, *p* < .001***	Z = -1.897, *p* = .058	**Z = -2.887, *p* = .004***
Unrel INMI VS Rel INPod	**Z = -3.000, *p* = .003***	**Z = -2.309, *p* = .021***	**Z = -3.000, *p* = .003***
Rel INMI VS Rel INPod VS Unrel INMI	**χ^2(2) = 20.667, *p* < .001***	χ^2(2) = 5.778, *p* = .056	**χ^2(2) = 10.111, *p* = .006***

3.4.2 Discussion

The results showed a reliable difference in the experience of related INMI when comparing the Music Test condition and the Podcast Test condition. No reliable difference was observed between the Silence and the Music Test conditions. This is suggestive of a training effect, where an association is made between activity and sonic environment. On the other hand, an INMI experience may additionally occur in silent contexts.

A further, promising result with respect to the conditioning hypothesis was found in the categorical comparison of Rel INMI and Unrel INMI in the Music Test. Only in the Music Test condition, the two types of INMI differed from each other, with a greater number of Rel INMI than Unrel INMI. This is an additional indication that the manipulation worked.

The categorical frequencies indicated a general trend with the Rel INMI being relatively frequent in the Music Test condition, while having similar frequency of occurrence in the other conditions with similar frequencies as Unrel INMI, which may suggest a baseline of INMI for this participant group.

No podcast was reported in the Music Test condition, whereas there were a few reports of Rel INPod in the other two test conditions. This may be further indicative of a learned association.

3.5 General discussion

This chapter aimed to investigate the relationship of INMI and activities, and more specifically, the possibility of INMI being expressed as a conditioned response in the absence of music, after a certain period of training. The designed studies intended to test whether INMI would occur in the condition that was previously paired with music, as opposed to the other two conditions that were paired with podcast and silence, respectively.

To consider the manipulation successful, several predictions had to be satisfied: firstly, INMI of the music of the experiment (Rel INMI) had to be significantly higher than other INMI (Unrel INMI), in the condition that was previously paired with music (Music Test condition). Secondly, Rel INMI had to be significantly higher in the Music Test condition than in the other conditions (Podcast Test and Silence Test conditions).

The first claim was met only after the combination of the two studies, and when analysing the categorised data. This shows the difficulty of training INMI across a short period of time: participants may already experience INMI in the training and test sessions of music with which they are more familiar.

The second requirement was met in Study 1 as well as in the combined data of the two studies, confirming a learned association between activity and sonic environment, despite the proximity in time of the different training conditions. In Study 2, Rel INMI in the Music Test condition did have a higher mean than in the first study, but nevertheless did not show a significant difference with Rel INMI in the other conditions, which may have been due to the small number of participants. The higher mean may indicate that the manipulation did have a relatively strong effect, and the music and more training sessions in the second study did work better.

The similar rates of INMI (both related and unrelated) in the Podcast and Silence condition suggest that there may be a baseline of INMI to be expected in this kind of experiment. It is known from the literature (Bailes, 2009; Liikkanen, 2011) that INMI is a very prevalent phenomenon in everyday life. As such, this result ought to be expected. The changeability of this experience is something that this study has started to investigate.

Across the two studies, no Rel INPod was reported in the Music condition. Study 1 yielded several reports of INPod in the Podcast Test condition, but not of any statistical significance, and in Study 2, there was only one INPod report during the Silence Test condition. These reports could be by chance, but it is noteworthy that no reports of INPod were made in the Music Test condition and, in Study 1, (relatively) many in the Podcast condition, which may be indicative of a successful manipulation through the experiment.

The longer-term effect of training and systematic exposure to music in a particular context would be worth investigating, for example, by using Byron and Fowles (2013) research design and re-contacting participants after participation in a study (with Experience Sampling Methods). In this case, their design would have to be modified to include information for the pairing of the activities. Indeed, on an anecdotal note, a participant emailed back a week after the experiment saying that they had seen a picture of yarn and thought of the music from the experiment (in their case the yarn was paired with music).

4 INNMI as a mood regulation mechanism

4.1 Introduction

One of the general predictions of this thesis is that individuals will have conditioned themselves with music, throughout their everyday uses of music, and that will express itself in the form of INMI. With the agenda of testing this hypothesis, it was deemed necessary to explore some of the major music listening functions to test our predictions. This chapter focuses on the second experiment of this thesis, aimed at exploring another major aspect of music listening, which is mood regulation (Greasley & Lamont, 2011). Along the lines of the previous study, there is the hypothesis that INMI is the conditioned response; from that notion, it is expected that individuals who frequently use music to regulate their mood will experience INMI when in a certain emotional situation as an involuntary coping mechanism.

4.1.1 Aims and objectives

This experiment investigated whether INMI acts as a substitute for music, in situations that individuals had previously associated with music. This theory suggests that INMI is the expression of an unconscious conditioning process that individuals undergo through everyday music listening. Therefore, INMI occurrences are likely to coincide with music listening situations (as analysed in the Introduction chapter). As discussed in the literature review chapters, research shows that individuals use music to manipulate their mood (Lonsdale & North, 2011; Saarikallio, 2008). This experimental design aimed to investigate the occurrence of INMI in a situation where the participants would usually use music to regulate their mood; in the absence of actual music, it is predicted that INMI would act as a substitute to music.

The mood that was decided to be induced was stress. The selection of stress for this experiment derives from the psychology of music literature of functions of music listening (Groarke & Hogan, 2015; Saarikallio, 2011; Saarikallio & Erkkila, 2007). Individuals frequently report using music to lift their mood/spirits (Greasley & Lamont, 2006), as a regulatory strategy (Saarikallio & Erkkila, 2007), and to reduce or be distracted from stress (Juslin, Barradas, Ovsiannikow, Limmo, & Thompson, 2016; Shifriss, Bodner, & Palgi, 2014; Thoma et al., 2012).

4.1.2 Predictions

The expectations were that the test group (namely, individuals who use music as mood regulation strategy) would experience INMI more frequently in the stress condition than in a neutral mood condition. Furthermore, the INMI experienced would be of a similar style/type/genre to that which the individual is typically using to regulate their mood.

Based on previous studies (see Music and Activities chapter), a baseline of reported INMI was expected (around 10% of participants). However, this INMI may distinguish itself from stress-induced INMI by being triggered through recent exposure or being music of a different genre and type than the individual uses to regulate their mood.

4.2 Method

This was a mood manipulation experiment consisting of a condition including tasks that induce stress, and a condition with similar tasks in a format that does not induce stress. University students were recruited through a volunteers list and asked to fill out a questionnaire on their everyday uses of music. Volunteers were grouped according to their reported uses of music. The expectation was that in the stressful condition, individuals that use music for mood regulation would involuntarily generate/ experience INMI in order to regulate their mood with the aid of music. The mood induction method was a modified version of the Tier Social Stress Test paradigm (TSST, by Kirschbaum, Pirke, & Hellhammer, 1993). This paradigm has been tested in several studies and has yielded reliable and successful results in stress induction (Gassling, 2012; Kudielka, Hellhammer, & Kirschbaum, 2007; Skoluda et al., 2015). The experimental design was a within-subjects design with all volunteers participating in the neutral and the stressful condition. Mood and INMI were assessed before participation, and at the end of each condition.

4.2.1 Triers Social Stress Test

The TSST procedure relies on the anxiety that can be built up during demanding social situations. It involves a series of situations where the participant needs to perform in front of a judge.

The original TSST involved a series of stress-inducing conditions, and the levels of stress were measured through physiological measurements: blood and saliva tests, as well as a record of heart rate. The original TSST protocol consisted of twenty minutes, divided into four different sections of five minutes each: two anticipation/inactive periods and two test periods. The first five-minute block was the first anticipatory period, where the participant was asked to assume the role of a job applicant, and in the next five-minute block s/he needed to prepare for a five-minute self-introduction presentation, which s/he would (in the second phase) present in front of a microphone, a camera, and a committee of managers. In the second period (the first of the two test ones), the participant was expected to give the five-minute presentation, and, if s/he finished earlier, s/he would be prompted to continue until the five minutes has passed. In the third phase (test condition), the subject performed some mental calculations (continually subtracting 13 from 1022) out loud, again in front of an audience, and if s/he made a mistake they had to start over. After the final five-minute period, the subject was debriefed about the experiment and told that the whole process was being monitored by physiological measurements. The combination of the anticipation conditions and the active conditions enhanced the effect, as the participant had time to stress about their performance (before, on how they will do, and after, on how they did).

In this original paradigm, the control condition was a record of the subject's regular physiological measurements, as a baseline, without performing any of the test conditions, or an alteration of them. However, Het et al. (2009), designed a TSST experiment with matching control conditions to those of the original paradigm, as they thought it was a better control setup. They paired the conditions described above in the test condition, but all would be performed in an empty room, without the presence of the researcher or cameras/microphones, and they were considerably easier: five minutes preparation to speak about a movie, a novel or a recent holiday trip to control for the interview preparation, then five minutes free speech to control for the mock interview, then five minutes adding up the number 15 to control for the arithmetical condition, and five minutes rest. Similarly, von Dawans, Kirschbaum, & Heinrichs (2011) tested the same TSST paradigm with different control conditions: reading of a popular scientific test to control the preparation, reading in a low voice to control the mock interview condition, and enumerate series of numbers in a low voice (e.g. 5,10, 15, 20 etc.).

As the assessment of stress induction in this original paradigm was through physiological measurements, all participants were asked to abstain from caffeine, alcohol, and food in order to produce clean physiological data.

4.2.1.1 TSST paradigm of this study

This study utilised the protocol described by von Dawans et al. (2011). As the TSST paradigm has repeatedly yielded significant results on stress induction, in different experimental trials, for this project there will no physiological arousal measurements, and the validation of the mood induction will occur through a self-report questionnaire (PASA by Gaab, Rohleder, Nater, & Ehlert, 2005) and a mood rating following the Positive, Negative Affect Scale (PANAS) protocol (Watson, Clark, & Tellegen, 1988). The heart rate could be implemented in the experimental design of this project, but, as the ultimate goal was to investigate an involuntary process (INMI), it was considered best to keep the environment as ecologically valid as possible. The participants of this study were asked not to listen to any music prior to the experiment to minimize, as much as possible, INMI due to recent exposure (Williamson et al., 2011).

Moreover, at the end of the experiment the paradigm suggests a five-minute period of rest followed by a debriefing of the participant. In this experiment, the participant was asked to complete the stress questionnaire before the de-briefing, but after s/he had finished with the numeracy test, and after the 5 minute period where s/he was asked to soothe him/herself in order to allow INMI to occur. The questionnaire for the assessment of INMI was presented after the stress one, by using a customised questionnaire (for further details see the Material section of this chapter and Appendices C, D, E & F).

In an additional endeavour, to understand more about the nature of INMI in this framework, a short, semi-structured interview was added at the end of the experiment that assessed and obtained details on the nature of INMI, the general impression and state of the participant after the mood manipulation, and their music listening habits.

All participants were to complete both conditions, and the order of the conditions was counterbalanced.

4.2.2 Procedure

As mentioned, this was a mixed design with a within-subjects experimental manipulation of stress and two participant groups. All participants completed both conditions: the neutral mood condition and the stressful condition. The two conditions were counterbalanced in order across participants. The groups were defined after data collection, based on their answers from the pre-screening questionnaire. The protocol by von Dawans et al. (2011) was followed with a few amendments.

4.2.2.1 Before the experiment

All participants had to complete the pre-screening questionnaire before coming to the experiment to ensure that no volunteers would participate with a history of mental conditions, in the event that this experiment would evoke unwanted (or intense) counter effects. Moreover, individuals who were postgraduates and native-English speakers would not be proceeded to the experiment, as it was thought that the stress induction procedure would be less effective for them than for younger students, or for non-native speakers. Participants were instructed to refrain from music, as much as possible, in the morning prior to the experiment.

4.2.2.2 Experiment

The total duration of the experiment was approximately one hour, although some participants needed longer to answer the questionnaires, and therefore the whole duration increased.

On the day of the experiment all participants were greeted by the researcher upon arrival. The researcher took precautions to not be too friendly, to ensure as much intimidation as possible during the test condition, was dressed formally, and kept a professional and formal interaction.

Participants would then be informed on the experiment, and the procedure, and had the opportunity to ask questions and then fill in the initial, baseline questionnaires: the PANAS mood assessment for how the participant was feeling at that moment, for the past week and the past year, to assess general mood and the customised INMI questionnaire, and to assess whether the participant had INMI at that moment (see below on Questionnaires). Then the two blocks would start, in a counterbalanced fashion, for each participant.

The setup of the room would remain the same, however, in the control condition the camera was visibly off (it had a lid, and the researcher made sure to indicate it), and the researcher left the room. During the test condition, the participant would be clearly notified that the camera would be turned on, and the researcher made their presence notable in the room.

For the test condition, the participant would first prepare for the interview for five minutes and was given a full job description handout and a notepad to keep notes. In the next phase, the researcher notified the participant that the camera was being turned on, and that they had to stand on a mark on the floor and present themselves for five minutes, without the notes or the job description handout. After the interview, the participant would continue directly to the numerical task (for five minutes), continuingly subtracting 13, starting from 1022 and going down (1022-13=1009-13=996 etc.). The camera was still on, and there was the addition of a metronome that indicated the pace, starting at 40 beats per minute. The participants were told that they were expected to reach the first 10 numerical positions by the first minute, they would have to keep up with the pace of the metronome, which, if they did well would increase in pace, and if they made a mistake they would have to start over. Throughout the test condition, the researcher kept a straight and formal demeanour, without being friendly or helpful. After the numerical task, the participant was informed that the camera would be turned off, and that they could now relax without fixating on anything particular in the room, or speaking for five minutes. After the relaxation period, the participant completed the experimental questionnaires, comprising the PASA for the experimental manipulation assessment, the PANAS for the mood assessment and the INMI questionnaire (for a summary see Table 4.1 below).

In the control condition, the participant was alone in the room and a timed PowerPoint informed them when the time was over. The researcher came into the room between the tasks, to ensure the participant was well and engaged with the task. The first task entailed reading by themselves (see Extra material, for details) for five minutes, (the PI would come in to check-in after the five minutes), reading out loud in a low voice for five minutes (the PI would come in again after the five minutes), adding five going up (5+5=10+5=15 etc.) for five minutes (PI coming in after the five minutes), and then relaxing for five minutes. For the relaxation period, the PI was in the room, quietly, without distracting the participants, as it had proven difficult for the participants to remain by themselves without looking at their mobile phones or being distracted by something (continuing reading for example). After the five-minutes relaxation period, the participant filled in the experimental questionnaires.

After the participant had completed both conditions, there was a short, semi-structured interview (five minutes, see Extra material and Appendix H for details) and then the participant was debriefed. All participants were informed that this was a stress induction experiment, and that it was designed to be unpleasant and difficult to fulfil the purpose of the experiment. If the participant wished, the researcher would comment on their interview performance as well.

Table 4.1. Summary of experimental procedure

Initial questionnaires	
Control Condition (relax) (20’) (empty room, no camera, no microphone)	Test Condition (stress) (20’) (experimenter in the room as a judge, camera/ microphone)
5’ Reading of scientific journal	5’ Preparing for interview
5’ Reading in low voice	5’ Presentation of skills
5’ Numerical: Adding 5 starting from 0 (5,10,15 etc.)	5’ Numerical: Subtracting 13 starting from 1022 (1022-13=1009 -13= 996 etc. If mistaken start over + metronome)
5’ Relax and try to soothe yourself.	5’ Relax and try to soothe yourself.
Completion of questionnaires	Completion of questionnaires
5’ Semi-structured short interview.	

4.2.3 Material

4.2.3.1 Questionnaires

4.2.3.1.1 Pre-questionnaire

As part of the recruitment procedure, participants were asked to fill out an online questionnaire before being invited to participate in the experiment. This questionnaire included questions regarding their music listening habits, music education, whether they regulated their mood through music listening, and if they used other coping techniques to regulate their mood. Furthermore, this questionnaire asked participants to include their age, gender, mother tongue, and main occupation.

The questionnaire was based on existing, validated questionnaires and, in most respects, identical to the background questionnaire used in the second run of the Music and Activities experiment (Study 2, Chapter 3). It included questions from the IMIS questionnaire (Floridou et al., 2015) and the Goldsmiths Musical Sophistication Index (Müllensiefen, Gingras, et al., 2014), in particular, the questions related to active musical engagement and emotional experiences of music. The assessment of the use of music for mood regulation was done using the Music in Mood Regulation Scale (MMR, Saarikallio, 2008). (See the pre-screening questionnaire on Appendix C).

4.2.3.1.2 Experimental questionnaires

Mood was assessed with the use of the Positive Negative Affect Scale (PANAS) by Watson et al. (1988) as it has been verified as an effective validation of mood (Crawford & Henry, 2004; Karim, Weisz, & Rehman, 2011; Thompson, 2007; Watson et al., 2009). This was done at baseline and at the end of each condition. At the end of a condition, participants were asked to indicate their current mood, and their mood during the experimental trial that they had just participated in. The initial questionnaire (before the two conditions, as described in the Procedure) assessed the mood of the participant, not only for that moment, but also for the past week and the past year. This was an attempt to capture the manipulation of the experiment and the general disposition of the participant.

Furthermore, the presence of INMI was assessed at the start of the experiment, as well as at the end of each experimental condition. The INMI questionnaire was developed for this study and it included two Likert-scale questions on whether the participant had music in their head at that moment, and whether they found it annoying, on a scale from one to five. The other questions were open ended, and asked what the music of the INMI was, if and how/when they would listen to it, if they were enjoying it, and how it made them feel.

Finally, induction of stress was assessed, not only by using the PANAS questionnaire, but also the stress questionnaire, PASA, as used by Gaab et al. (2005). This includes questions related to primary indicators of experienced stress (Primary Appraisal) such as perceived threat and challenge, and secondary indicators (Secondary Appraisal), which relate to personal control and competence (Gaab et al., 2005; Het et al., 2009, see Appendix F).

4.2.3.2 Additional material and equipment

The reading material for the control condition required a text that was engaging, but not referring to any musical material. The text that was chosen was an excerpt from the Origin of Species, by Darwin (1909), which was given to the participants in a photocopy.

The camera used in the test condition was a large one with a visible microphone, set on a big tripod. Given the lack of a panel committee (as in the original TSST), the camera had to be as noticeable as possible, to create the sense of a formal procedure, and potentially enhance the stress induction.

The job that the participants were interviewed for was an administrative position at the University of Sheffield. Candidates had to prove, according to the job description, that they were fluent speakers, proficient in software packages, had strong organisational skills, were able to manage websites and schedules, as well as interact with other students. If the participant finished speaking before the five minutes they were prompted to continue, and then, if they did not, the researcher would ask them questions to keep them engaged.

4.2.3.3 Interview

The interview at the end of the experimental session was semi-structured and informal, and encouraged participants to provide more details about their INMI and their experience of the experiment. The questions included how the participant found the experiment, if they were focused or distracted, if they were engaged with it and its outcome, if they felt a difference between the two conditions (and in what way), if they felt stressed in the interview condition, and if they managed to calm themselves during the relaxation period. Then the researcher would ask whether they had music in their head at any point during the experiment: if yes, how it made them feel, what music was it, and if/when would they listen to it. Moreover, the interview included questions on whether they would listen to music when they were stressed, and if they could, would they want to listen to music at that moment. The participants were also asked whether they had an idea of what the experiment was about.

4.2.4 Participants

Volunteers were recruited using the University of Sheffield student volunteers list and were asked to fill out the online pre-questionnaire. Next, the participants were invited to participate in the experiment if they met the two conditions (using music for mood regulation, and not).

Participants with a history of depression or mental illnesses were exempted from this study due to the nature of the mood induction procedure, as stress might have affected these individuals more severely. Moreover, the use of music may be different under stressed conditions for this population and may influence the results. An extra requirement was made for participants being either undergraduates or postgraduates who were non-native English speakers, and so were added to increase the chances of successful manipulation. The more experienced individuals, such as postgraduate students, could be more comfortable with their interviewing skills as well as with having the skills for the advertised position, particularly when being a native English speaker.

There were 27 participants who completed the pre-questionnaire and the experiment. The study initially had 28, but the data of one participant was excluded from the results as they used their mobile phone during the relaxation periods. The participant pool consisted of 12 British participants, 16 males, and 14 native English speakers. The educational level of the participants was mostly at undergraduate level (18 participants), while there were five postgraduate students. The participants' age ranged mostly from 18–25 (22 participants), while there were three participants in the age range of 26–40.

On the basis of the pre-questionnaire, participants were divided into two groups: 11 participants were found to use music to regulate their mood, and the other participants were found not to listen to music for the purpose of mood regulation—they may use other means for mood regulation (knitting, reading, etc.).

The requirements of the mood-listening classification were a set of variables from the MMR (as described above) in the pre-screening questionnaire, from which the Mean was calculated. If a participant had a mean rating above 4, on a scale of 1–5, and they had also ticked the option of 'I use music to change or enhance my mood', then they were considered as using music to regulate their mood, henceforth named as mood-listeners, for brevity. These variables were (as they appear on the pre-screening questionnaire, see Appendix C):

- 12. Listening to music does not help me to relax (Reversed)
- 13. I mostly use music to relax and unwind
- 18. Listening to music helps me to relax
- 21. When I feel bad, I try to get myself in a better mood by engaging in some music-related activity
- 22. I cannot push my worries aside with the help of music (Reversed)
- 33. In a stressful situation I listen to music to relax

The variables described above were averaged before classifying the response. The mood-listeners' category included the combination of the variables with an average score above 4, and the non-mood-listeners the rest of the participants.

4.2.5 Ethics

This study has been approved by the Ethics Committee of the Department of Music at the University of Sheffield (No 006431, 21/12/2015). All participants were thoroughly informed and had the right to withdraw from the study at any given time. Volunteers were invited to participate in a mock interview experiment, to assess how music listening habits would affect performance in different situations, without any reference to INMI in particular.

4.3 Results

4.3.1 Pre-screening results

During the analysis of the pre-screening questionnaire, an issue came up, with two participants responding twice to it, with slightly different answers. Since the answers in the mood-listeners' variables were the same, the first version was kept, so as to keep it similar to the other participants who saw the questionnaire for the first time.

4.3.2 Experiment results

Data and variables were tested for normality, but normal distribution could not be assumed. Therefore, statistical evaluations were based on non-parametric Wilcoxon t-tests, and Spearman rho correlations. Furthermore, wherever meaningful, means and cross-tabulations are reported.

4.3.2.1 Mood manipulation

The mood manipulation was generally deemed as successful. The most stressful condition, based on the Negative PANAS scores, was the test condition, with the mean negative affect during the test condition being 2.00 (SD=.51, N=27, Min=1, Max=5). The mean of the condition that followed in stress was that of the baseline rating (M=1.77, SD=.49), closely followed by the rating of that after the test condition (M=1.73, SD=.47). The two ratings from the control condition were very close: at 1.41 for after the relaxation, and 1.47 for during the control condition. Participants were most happy with their mood during the relaxation after the control condition (M=3.81, SD=1.07), followed by the rating during the control condition (M=3.7, SD= 1.17). The rating during the test condition was the highest for participants wanting to change their mood (M=2.8, SD=1.3).

However, some discrepancies were observed in the homogeneity of the two groups: as seen in Table 4.2, the mood-listeners and non-mood-listeners were not on all occasions equally affected.

Table 4.2. Comparison of Affect measures in control and test condition using Wilcoxon Test for related samples. The first rows relate to the PANAS questionnaire and the final three rows to the PASA questionnaire.

	All[3]		Mood listeners[4]		Non-mood listeners[5]	
	Z	p	Z	p	Z	p
Negative Affect Now Test VS Control	-3.067b	.002*	-2.938c	.003*	-1.433c	.152
Positive Affect Now Test VS Control	-1.316b	.188	-.534c	.594	-1.052c	.293
Negative Affect During Experiment Test VS Control	-3.624b	<.001**	-2.937c	.003*	-2.170c	.03*
Positive Affect During Experiment Test VS Control	-.916b	.359	-.445d	.656	-1.704c	.088
Negative Affect Now Baseline VS Test	-.030b	.976	-.757d	.449	-.747c	.455

[3] N=27
[4] N=11
[5] N=16

Negative Affect Now Baseline VS Control	-3.538c	<.001**	-2.946c	.003*	-1.889c	.059
Positive Affect Now Baseline VS Test	-2.270c	.023*	-.871c	.384	-2.309c	.021*
Positive Affect Now Baseline VS Control	-2.898b	.004*	-1.070c	.285	-2.866c	.004**
Mean Threat Test VS Control	-2.473b	.013*	-1.140c	.254	-2.212c	.027*
Mean Challenge Test VS Control	-1.930b	.054	-1.582c	.114	-1.155c	.248
Mean Abilities Test VS Control	-2.437b	.015*	-2.051c	.04*	-1.404c	.16
Mean Control Test VS Control	-4.480b	<.001**	-2.821c	.005	-3.532c	<.001**
Mean VAS Test VS Control	-.662c	.508	-.767c	.443	-1.612d	.107

Wilcoxon Signed Ranks Test, *p* (2-tailed), b. Based on positive ranks, c. Based on negative ranks.

This inconsistency within the groups is examined below, as stress induction was seen as necessary for the INMI induction.

4.3.2.2 INMI during the experiment

There were two different questions assessing INMI throughout the experiment: one categorical, with yes, no, and not sure answers that was incorporated in the experimental questionnaire which gathered information for both the moment that the participants filled in the questionnaire, but also retrospectively for during the experiment. The other set of questions was in a separate questionnaire and it regarded whether they had INMI at that moment, being rated from 1–5, along with further details about that INMI (see method materials and Appendices E & F).

The data from the categorical variable suggest that the number of participants reporting INMI at the end of the control and test condition was the same, at seven participants. Additionally, they were asked to report whether they experienced INMI during the test condition. For this, only one participant reported to have experienced

INMI in the test condition, as opposed to six participants during the control condition (see Table 4.3).

Table 4.3. Categorical INMI reports in the Test and Control conditions

	Yes	No	Not sure
INMI Now Stress	7	17	3
INMI Now Control	7	17	3
INMI during Stress	1	23	3
INMI during Control	6	21	0

This shows that, overall, there was no difference between the frequency of INMI across the two conditions, and, if anything, there was a greater tendency to experience INMI during the control conditions. Our interest was primarily concerned with the role of INMI in the relaxation period, particularly for mood-listeners. Therefore, the mood-listening variable was implemented in the analysis and the focus was on the 'INMI Now reports'. Table 4.4 displays the results of the non-parametric t-test analyses that were performed between the INMI in the three different measurements (baseline, test, and control) across the whole pool of participants, but also on the individual groups, based on mood regulation by music or not.

Table 4.4. Wilcoxon signed rank analysis of INMI in conditions

		INMI Now Test VS Baseline	INMI Now Test VS Control	INMI Now Control VS Baseline
All[6]	Z	-0.758[b]	-1.199[c]	-0.787[b]
	p	.449	.23	.431
Mood listeners[7]	Z	-.354[c]	-1.054[d]	-1.063[c]
	p	.723	.292	.288
Non-mood listeners[8]	Z	-1.134[c]	-0.447[d]	-0.577[d]
	p	.257	.655	.564

Wilcoxon Signed Ranks Test, *p* (2-tailed), b. Based on positive ranks; c. Based on negative ranks.

[6] N=27
[7] N=11
[8] N=16

This table (Table 4.4) shows no reliable differences between the two conditions or in comparison to the baseline for either group. However, these results need to be further qualified with respect to the effect of mood manipulation. Although, in general, the mood manipulation worked, not all participants were equally affected by the manipulation. Indeed, if the experienced negative affect is correlated (Negative PANAS score) with rated INMI (Now and During), a significant positive correlation is observed (see Table 4.5).

One of the main aims of this study was to examine whether there would be a correlation between stress and INMI in the individuals who use music listening to regulate their mood. Table 4.5 illustrates the different correlations between the INMI variable and the negative affect ratings, across the conditions, for the two groups (people who use music to regulate their mood: mood-listeners, and people who do not: non-mood-listeners). The only significant correlation was that of the non-mood-listeners, in the baseline rating, something that may suggest that those participants may have had INMI before coming to the experiment (although this does not explain the observed relationship between INMI and Negative Affect). This relationship was present from the start and therefore seemingly not due to the experimental manipulation.

Table 4.5. Correlations between INMI and Negative Affect

INMI * Negative Affect (PANAS)						
		After test	During test	After control	During control	Baseline
All	r	.45*	.45*	-.10	.15	.11
	p	.02	.02	.96	.46	.57
Mood listeners	r	.47	.38	-.21	-.09	-.59
	p	.15	.25	.54	.78	.06
Non-Mood listeners	r	.45	.47	.15	.28	.51
	p	.08	.07	.59	.29	.05

*Correlation is significant at the .05 level (2-tailed).

The issue of whether the mood manipulation worked equally within the groups was a matter for further investigation. If the mood manipulation did not work, then no INMI would be expected from the mood-listeners, at least not any more than the non-mood-listeners. Indeed, the data from the interview suggest that, even though the mood manipulation did work for the majority of the participants, some of the participants did not feel particularly stressed. Therefore, the two groups were further divided to explore any possible differences in affect between the mood-listeners who did report INMI, and the mood-listeners who did not. The new variable that was created to examine such a possibility, was computed by co-calculating the reports from the binarised mood-listening variable, and reports equal to or above three on the INMI variable. Participants from the two groups were split into four: the ones having reported INMI and the ones who did not (see Figure 4.7 for an outline of the groups). The Mean Affect rating for those groups indeed suggests that the mood-listeners who reported INMI had, in most Affect categories, the highest ranking, and a difference between the two mood-listeners group was observed.

Table 4.6. Mean ratings for Negative Affect

		Baseline	During Stress	After Stress	Threat	Challenge	Abilities	Control	VAS
Mood-INMI N=5	Mean	1.78	2.44	2.24	2.35	3.20	3.25	3.70	3.30
	Std. Dev.	0.34	0.26	0.34	0.68	0.67	0.79	1.04	0.67
Mood-No INMI N=6	Mean	2.00	2.08	1.73	2.38	2.75	2.71	3.17	4.17
	Std. Dev.	0.55	0.55	0.59	0.44	0.52	0.49	0.26	0.41
Non-mood INMI N=5	Mean	2.00	2.22	1.88	2.65	2.70	3.05	3.60	3.70
	Std. Dev.	0.37	0.47	0.33	0.80	0.27	0.94	0.65	0.76
Non-mood-No INMI N=11	Mean	1.54	1.66	1.44	2.57	2.86	3.05	3.05	3.55
	Std. Dev.	0.50	0.40	0.32	0.57	0.55	0.90	0.91	1.11

The box plots in Figure 4.2, Figure 4.4, and Figure 4.6 show that the level of stress of the groups was not equal for the conditions. Figure 4.2 shows the answers of the mood-listeners for both Negative Affect and INMI during the Baseline condition. Figure 4.4 depicts this combination for the Test (stress) condition, and Figure 4.6 for the Control condition.

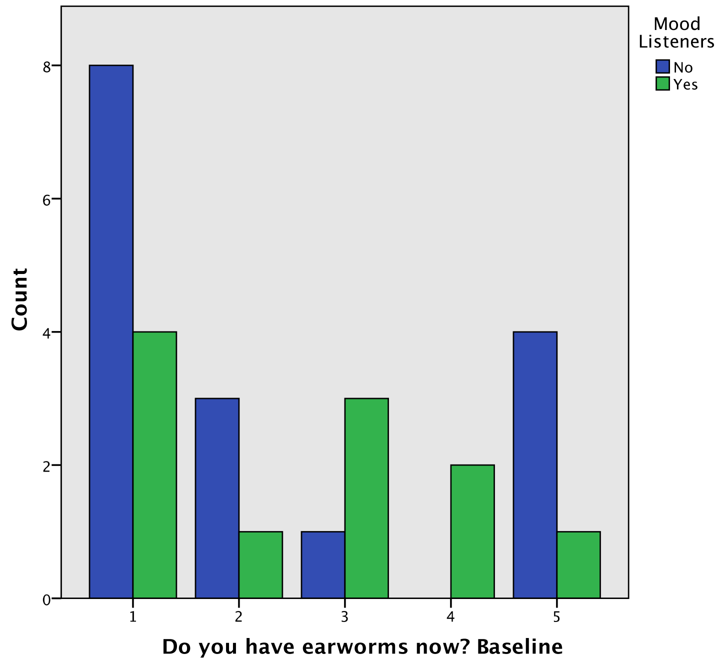

Figure 4.1. Bar chart of INMI ratings on Baseline condition

While all mood-listeners have a variety of Affect and INMI ratings for the Control condition, the Stress condition results indicate a fluctuation between the group. The boxplots illustrate that the group of mood-listeners who did not rate high on the Negative Affect (meaning that they reported being stressed) were also the ones who did not report INMI, whereas the mood-listeners who did get stressed were the ones reporting INMI. (see Figure 4.4)

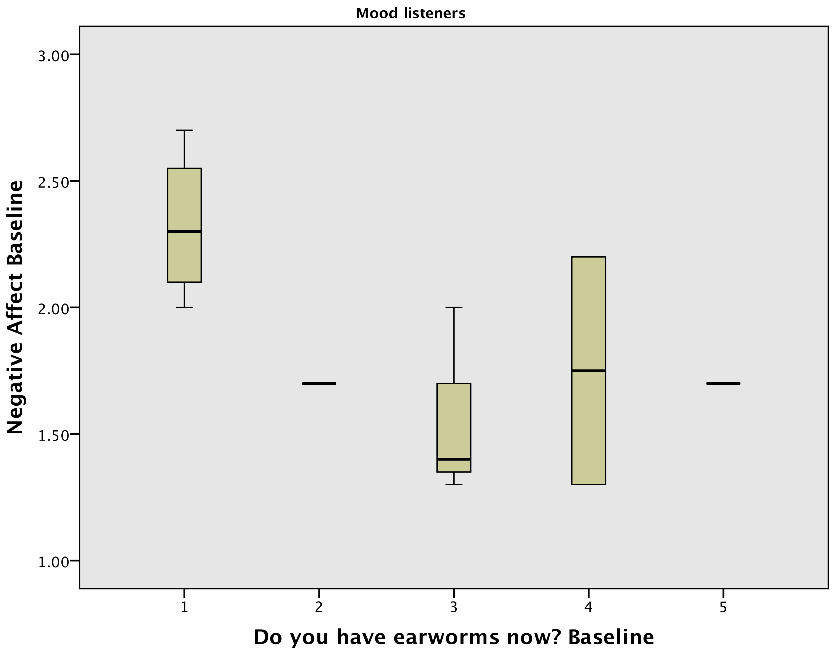

Figure 4.2. Box plot of INMI and Negative Affect (PANAS) responses of the Mood-Listeners group, during the baseline measurements

When taking into account both groups, a significant correlation between the Negative Affect and INMI during the Test condition was found (r=.45, *p*=.02, *N*=27). However, this correlation is probably based on the negative responses, rather than the positive ones. The same significance is apparent after dividing the two groups, with the Negative Affect during the Test condition being significantly correlated to INMI for the non-mood-listeners. This correlation was not significant for the mood-listeners group.

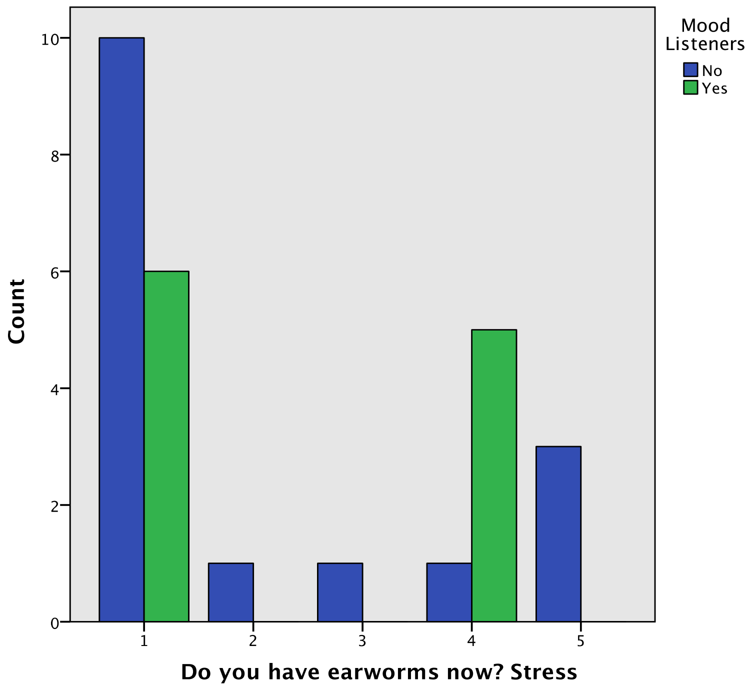

Figure 4.3. Bar chart of INMI in Stress condition

An interesting finding is that the mood-listeners' group's answers were polarised on INMI answers on the test condition. Figure 4.3 shows that they either answered completely negatively (1) on having INMI, or positively (4), without other ratings. This was not the case in the other conditions, baseline, and control, in which the answers were spread more broadly (see Figure 4.1 & Figure 4.5).

Figure 4.4. Box plot of INMI and Negative Affect (PANAS) responses of the Mood-Listeners group, during the Test measurements

To further investigate the level of Negative Affect on the participants, it was decided to calculate the difference of the Test Negative Affect and the Baseline Negative Affect. This difference yielded a number that reflected the size of the difference between the two measurements: the bigger the number, the higher the stress in the test condition in relation to the baseline measurement. This effectively showed the level of each participant's stress.

To further assess this premise of mood-listeners having INMI when they were stressed enough, a cross-tabulation was calculated for the answers of the mood-listeners of the INMI in the test condition, and the difference between the Negative Affect (PANAS) during the test condition and the baseline measurement. Table 4.7 illustrates the answers of the mood-listeners on INMI and the calculated difference between Negative Affect on Test, minus the Negative Affect on Baseline conditions.

As seen in Table 4.7, the negative INMI answers fluctuate between -0.2 (meaning that the baseline negative affect measurement was actually higher than the test condition) and 0.3, while the positive answers start from 0.3 and vary up to 1.1. This suggests that the INMI reports from the mood-listeners seem to concentrate on either side of the spectrum: as the difference of the affect between the Negative PANAS Baseline and Test condition gets bigger (meaning that the negative ratings were higher in the Test condition), the more mood-listeners report INMI.

Table 4.7. Cross tabulation of INMI in Mood-listeners and Negative Affect difference

	INMI rank	Neg PANAS During Test – Neg PANAS Baseline							
INMI after Test		-0.2	-0.1	0.1	0.2	0.3	0.8	1.1	Total
	1	1	1	1	2	1	0	0	6
	4	0	0	0	0	2	2	1	5
	Total	1	1	1	2	3	2	1	11

		Neg Panas During Control – Neg Panas Baseline												
INMI after Control		-1	-0.4	0	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.3	1.8	Total
	1	1	1	2	0	2	1	0	0	1	0	1	0	9
	2	0	0	0	1	0	0	1	0	0	0	0	0	2
	4	0	0	0	0	0	0	0	1	0	1	0	0	2
	5	0	0	0	0	1	1	0	0	0	0	0	1	3
	Total	1	1	2	1	3	2	1	1	1	1	1	1	16

While the ratings of INMI after the control condition do not show any patterns, the pattern of the ratings for the Test condition does suggest that, during the test control, the level of negative affect seems to show a trend corresponding with the INMI reports. This relationship was further established when performing a correlation on the difference of the Negative Affect between the Baseline and the Test condition: the correlation was significant for the mood-listeners (r=.75, p=.007, N=11) but not for the non-mood-listeners (r=.013, p=.962, N=16).

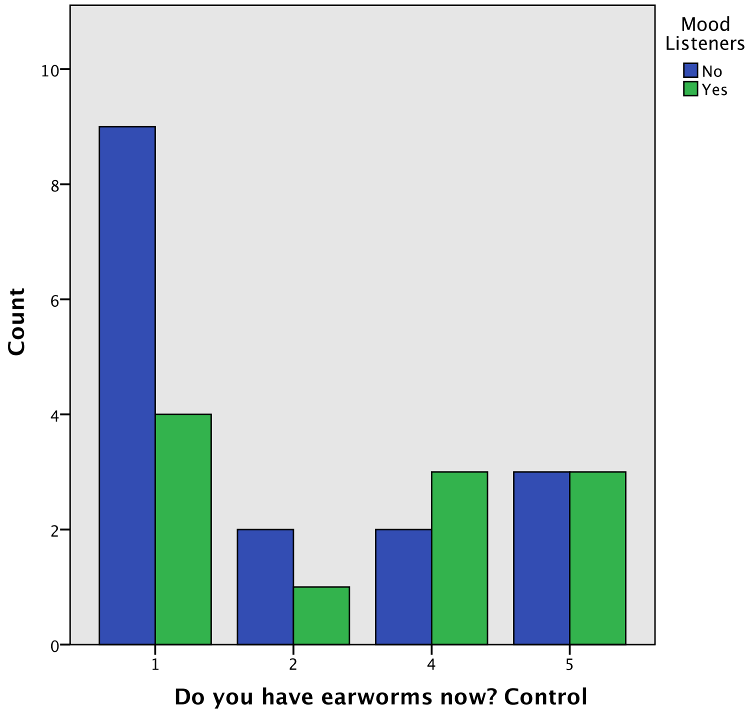

Figure 4.5. Bar chart of INMI ratings in Control condition

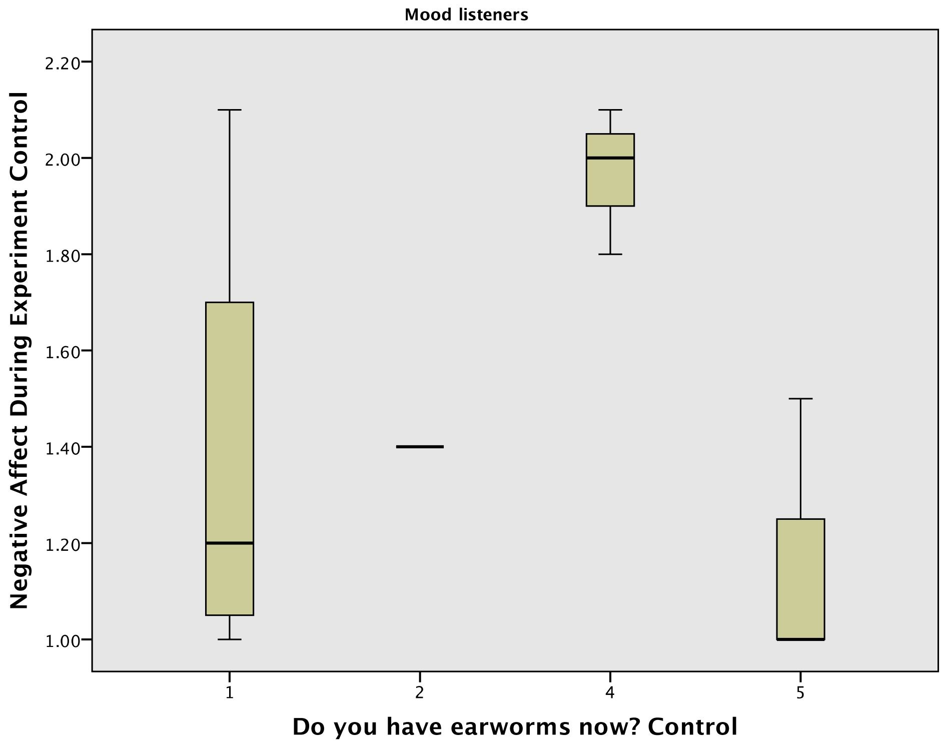

Figure 4.6. Box plot of INMI and Negative Affect (PANAS) responses of the Mood-Listeners group, during the Control measurements

Figure 4.7 illustrates the answers for the INMI of the Test condition and the Negative Affect during the Test condition: the four different boxes represent the two groups, further divided into the participants who did have INMI after the Test condition, and those who did not. From the boxplot it appears that for both mood-listeners, and non-mood-listeners, the participants who reported INMI were the ones who were more stressed.

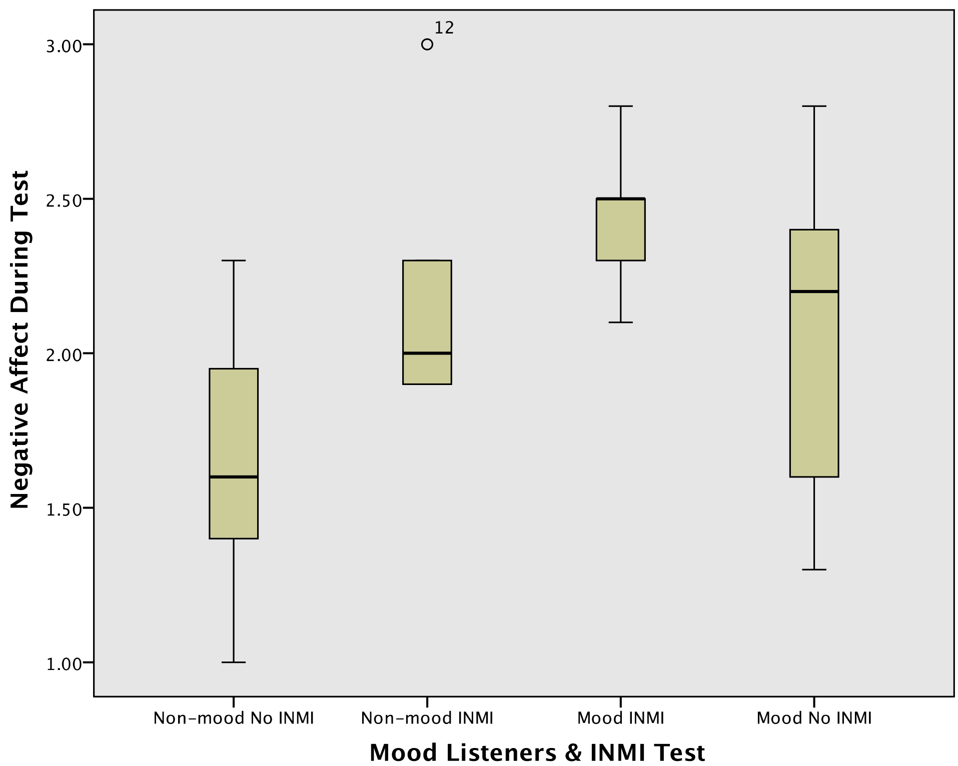

Figure 4.7. Box plot of Mood-Listeners' INMI and Negative Affect (PANAS), and the measurements during the stress condition

4.4 Discussion

The mood manipulation generally worked, with the test condition being rated as significantly more stressful than the control and the baseline ratings (see Table 4.2). However, there was a variance between the groups in certain affect variables. This could be worthy of further investigation to address whether it was a matter of individual differences, which have been reflected in statistical weakness due to the small pool of participants.

There was no difference between the INMI in the Test and Control condition; on the contrary, the reports from the two conditions were identical. This could effectively mean that the manipulation to induce INMI did not work, since the ratings of the two relaxation periods were the same. Moreover, many people reported having INMI when they came to the experiment (11 participants rated having INMI above 3 in baseline INMI), as well in the Control condition (11 participants rated above 3), and the Test condition which had the lowest number of participants (10 participants rated above 3).

However, these results can be expected and may not contradict the hypothesis, as the experimental design did not aim to induce INMI in the general population, but rather only in individuals who listen to music to regulate their stress. Nevertheless, after analysing and classifying the participants, and dividing them into those who listen to music when they are stressed (mood-listeners) and those who do not (non-mood-listeners), there was still no reliable correlation between negative affect and INMI.

However, upon closer inspection of the stress levels of the mood-listeners, it was apparent that the group's negative affect ratings were not homogenous. After the implementation of the Mood Listening variable, and the further division of the participants into those who were mood-listeners or not, and did report INMI or not, the mood manipulation did correlate with the mood-listeners having INMI. As seen in Table 4.7, there was a variation in the levels of negative affect within the mood-listeners group. For the experimental manipulation to work, the mood-listeners would have to be in an emotional situation that would resemble their music listening habits—being stressed. If some of the mood-listeners were not sufficiently stressed, that would be reflected in their INMI reports. Indeed, Figure 4.4 illustrates that the group of mood-listeners were not equally stressed, and that the ones who reported INMI were the more sensitive to the mood induction, whereas the least affected did not report INMI. This suggests that even though there was no reliable difference between the INMI of the mood-listeners and the non-mood-listeners, there is a trend towards the hypothesis: the mood-listeners who did get stressed, did report INMI. More participants would increase the statistical power and enable us to draw definite conclusions.

The different levels of stress within the mood-listeners (as seen in Table 4.7), but also the variance of the negative affect levels in both groups (as seen in Table 4.2 & Table 4.6), make for another point of discussion. While the overall effect of the mood manipulation was successful, the groups presented differences on that effectiveness. We know from past studies that uses of music have often been found to correlate with certain personality traits (Chamorro-Premuzic & Furnham, 2007; Vella & Mills, 2017). Perhaps screening for participants using music for mood regulation confounds with having other characteristics as well, such as, for example, neuroticism personality traits (Chamorro-Premuzic, Swami, & Cermakova, 2012) that could potentially trigger different individual’s reactions in a stress induction experiment.

4.4.1 Limitations

Certain limitations were highlighted while analysing the data. First, an issue was raised due to certain discrepancies in the ratings: some participants rated low on having INMI on the rating answers, and negatively at the categorical, yet they could provide the details of their INMI in the open answer box, meaning that they did have music in their head, and one that they could recognise (see Appendices E & F). Moreover, two participants had, by accident, completed two entries into the pre-screening questionnaire, and, upon closer inspection, their two entries were not identical. Since their answers on the questions regarding the classification into mood-listeners were identical, it was decided that only the first entry for each would be admitted. However, these inconsistencies raise the question of how people assess themselves, and their INMI, and how reliable a questionnaire can be on researching INMI.

Secondly, while several precautions were taken in identifying the mood-listeners, by implementing a set of categories that the mood-listeners would have to adhere to, the classification can be problematic. The question of what is considered to be mood listening, and whether the set of requirements was able to successfully classify a participant as a mood-listener or not, is still a valid question. Some participants may have fallen under the radar by using music in that way, and not recognising to do so, or not doing it in all the ways that were set by this classification.

Lastly, some limitations arose due to the design of this experiment: firstly, the fact that no music listening was allowed on the day of the experiment, although deemed necessary, may have solicited more INMI. Upon investigating the matter of whether refraining from music would result in more INMI, in Chapter 5, there was no such connection observable, but, nevertheless, it could be something that has affected the participants' INMI experience. Secondly, something to consider was whether the schedule of the experiment would be the same for the relaxation of the participant and therefore the time to have INMI: while participants were still in the experimental setup, they might not have relaxed in the same way they would if they were in another environment. Indeed, INMI might have come later, or not at all, as music is not the always the sole method to relax and decompress.

4.4.2 Conclusions

This experiment did not yield any significant results regarding the INMI between the two groups that were targeted, namely, the mood-listeners and the non-mood-listeners. There was no statistical difference between the INMI of the two groups in the Test condition, nor any significant correlations between the INMI of the participants and the level of negative affect in the Test condition. Moreover, there was no noticeable difference between the INMI of the mood-listeners in the Test condition, as opposed to the Control condition. However, there is some evidence supporting the hypothesis: the variation of the stress levels within the mood-listeners, the trend on the affected mood-listeners reporting INMI (as opposed to the non-affected mood-listeners who did not), and the significant correlation between the INMI of the mood-listeners and the difference of the Negative Affect. These findings are encouraging to the hypothesis, and more participants and/or a modified experimental design that would boost the stress effects of all participants, could lead to different conclusions.

5 INMI in everyday life: music listening habits, genres

5.1 Introduction

The previous two studies have examined the phenomenon of musical imagery in a laboratory context, attempting to replicate the conditions that may be responsible for INMI. This study, however, takes another angle and aims to examine the phenomenon of musical imagery (MI) in the everyday life of individuals. Everyday life research gives insights into actions that most individuals do not even notice, allowing the researcher to uncover unconscious patterns. As there are many functions of everyday life that pass unnoticed, it is crucial to rely as little as possible on retrospections, and instead to focus on a live-feed of information. A frequently-used and successful method, as will be discussed later in the chapter, to research the everyday life of individuals is the Experience Sampling Method (ESM, see more on Hektner, Schmidt, & Csikszentmihalyi, 2007). In ESM, individuals are being instructed to report on the activity that is the focus of the study, which provides insight into the behaviours of the individuals, having the benefit of yielding ecologically-valid reports and imposing minimal invasion on the participants (Randal & Ricard, 2014).

In this chapter, the research question is investigated under the scope of everyday life, with the ultimate goal being to examine whether music listening and INMI are associated in terms of activities, moods and/or types of music. This study followed the ESM paradigm, in order to examine individual differences between participants in everyday music listening, explore systematic uses of music, music listening habits and relationships with the occurrence of INMI in real-life situations. As the other two studies of this thesis were laboratory based, it was deemed logical for the third study to be in a real-life framework.

5.2 Aims and objectives

This study is a continuation of a previous ESM study (Filippidi & Timmers, 2017), which explored the association of music listening and INMI in everyday life, through a broad questionnaire and a small-scale diary study. From the results, a level of correlation between music listening and INMI did emerge in terms of activities, moods, functions of music listening etc. The current study aims to solidify the findings by documenting the music listening habits of individuals and INMI occurrences on a daily basis in greater detail.

An extra element was added in this study to test the conditioning hypothesis: if INMI is a conditioned response, then it would appear in situations when music would be present. Therefore, an attempt was made to simulate an environment of musical deprivation, by asking the participants to abstain, where possible, from music listening. This would potentially generate 'withdrawal symptoms', such as imagining music in compensation. This artificial deprivation aimed to increase observable parallels between functions of musical listening and manifestations of INMI. From the hypothesis, it was expected that individuals who use music in their everyday life, would experience INMI equivalent to their music listening. It was also hypothesised that INMI would appear in different forms and for different reasons, depending on the individual: for example, it could occur in situations that were associated with music, or an individual would have INMI of a specific genre since this is the type of music that individuals listen to in their everyday life listening etc. In principal, INMI could potentially emerge when music has been sufficiently associated with a certain state. Recording the music listening, and the everyday routines and habits of individuals, may shed further light into why MI happens. Musically-engaged individuals may exhibit enhanced INMI activity (as Wammes and Barruss', 2009, data suggests) in terms of quantity of the experience, while the quality may not get affected, as Weir et al.'s (2015) results suggest. The expectation is that individuals may experience more INMI than usual (in the abstinence of music listening). However, for testing the hypothesis, qualitative differentiation is the main interest: it is the nature of the INMI episodes, and the circumstances (semantic and episodic) in which they happen, that will be examined.

The extra implementation that was discussed above, to ask our participants to refrain from music listening as much as possible, will allow us to further examine the effect this would have on INMI. The frequency of INMI, quality, and affect could potentially be different. The idea behind such a move was partially inspired by an action of Trevor Cox [9], a Professor of Acoustic Engineering at Salford University, who 'gave up' music listening for Lent. As one of the main factors for having INMI is recent exposure (Williamson et al., 2011), and recent exposure is the key element for having INMI, then abstaining from music would potentially decrease INMI reports. If, however, there is another, underlying mechanism behind INMI (the conditioning hypothesis that I am proposing in this thesis), then instead of decreasing, INMI would be increased. Therefore, a period of observation of normal music listening and everyday life (referred to hereafter as 'normal' or 'non-diet') was to precede another period of no music listening (referred to hereafter as musical diet), to assess possible differences and similarities.

5.2.1 Expectations

Our expectations were that INMI would be highly influenced by the music listening habits. This influence could be regarding the situation of the individual, i.e. being in a condition that the individual has associated with music. Moreover, the influence may regard the genre of music, i.e. INMI being of a genre that is of the musical taste of the individual, or simply the one that they are listening to. INMI may happen in instances where the individual would listen to music or would want to listen to music. Another possibility is that having INMI would even be interpreted as a trigger to listen to music.

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[9] https://twitter.com/trevor_cox; https://www.huffingtonpost.com/trevor-cox/giving-up-music-for-lent_b_6687498.html

5.3 Method

5.3.1 General hypothesis target

The purpose of this study is to investigate the degree of connection between music listening habits and INMI, along with the general conditioning assumption of the thesis. ESM was deemed the appropriate method, as it is one of the accredited methods of investigating phenomena in everyday life (Hektner, Schmidt, & Csikszentmihalyi, 2007). ESM has been used to investigate behaviours in music (Greasley and Lamont, 2011; North et al., 2004; Randal & Rickard, 2016; Sloboda et al., 2001) and musical imagery (Bayles, 2007; Floridou et al., 2015), but also in other disciplines, such as measuring creativity (Silvia, et al., 2014), dieting (Hofmann, Adriaanse, Vohs, & Baumeister, 2014), and mood assessment (Nisenbaum, Links, Eynan, & Heisel, 2010).

5.3.2 Background survey

At the beginning of the study, participants completed a background survey. Sociodemographic information was collected including age, gender, educational level, and nationality. Musicality of the participants was assessed using the Goldsmiths Musical Sophistication Index Gold-MSI by Müllensiefen et al. (2014). Frequency and typology of INMI were recorded by using the IMIS questionnaire by Floridou et al. (2015), and incorporated some questions designed specifically for this study. Participants were asked to reflect on their typical uses of music listening by using as a guide the main categories found by Juslin et al. (2008) and Sloboda et al. (2001); their uses of music for mood regulation by using the Music and Mood Regulation tool as designed by Saarikallio (2008); and their music genre preferences by following Rentfrow and Gosling's (2003) extensive list of musical genres, but also having the option of adding their own genres.

Controlling for other effects that may confound with the experience of musical imagery was necessary. Previous research has shown that several factors may account for and/or play a role in the occurrence of musical imagery: as seen in the Literature chapter, one strong element that often correlates with having INMI is personality traits. Neuroticism has been found to be correlated with several characteristics of INMI (Floridou et al., 2012); extraversion and openness to experience were found to be correlated with certain INMI features (Floridou et al., 2012); while Wammes and Barušs (2009) and Bailes (2015) found that Trasliminality has been correlated with the type and frequency of INMI. This thesis argues that, instead, the correlation is between music listening and personality and INMI is the confounding effect. An extensive Big Five Personality Test was included in the background survey to investigate these possibilities. The tool that was used was the credible and most widely-used survey by John and Srivastava (1999), but with the addition of having a 7-point Likert scale instead of 5. All the other elements were used as in the original.

Participants were given a definition of INMI at the start of the study, in an attempt to include all reports of INMI, regardless of whether it was looping, being repeated or otherwise, and also to reduce the effect of any positive or negative connotations with the word earworms. The definition was as follows:

> Involuntary musical imagery (INMI) is the name for the experience of having music in your head, unsolicited, without actual music playing. This can loop and repeat, or it can just play for a while (or even once) and then stop. You might have heard it recently or can't remember when you heard it last. INMI can be pleasant or annoying or even something in between. Please think of how the experience is for you when answering the questions below.

The background survey finally included questions regarding details of the ESM alerts and forms, such as preferences on the dates, alert method (text, email, or both), their preferred 12h time window and any specific requests not to be disturbed. Further instructions and a test alert were scheduled accordingly.

5.3.3 Experience Sampling Method

The study was conducted through cues that were sent to the participants, and as soon as convenient they would fill out a Google form (hereafter referred to as ESF), through a link that was provided. The ESF was designed to be easy to administer, and the only requirement to participate was that the ESF had to be accessed via an internet connection and to have a means to receive the alerts (mobile phone or personal computer).

The ESF was designed to record the music listening experiences and the INMI experiences of the participants, with minimal retrospection. Participants were asked to record what they were listening to and what musical imagery they experienced at the moment of the alert or directly preceding it. An email and/or a text (according to personal preference) was sent six times a day, notifying the participant to fill in the given Google form. The emails were scheduled by using the Boomerang plugin for Gmail, and the texts were scheduled from Android's built-in function. Both alerting methods were supervised by the PI.

The study was conducted for six days, and participants received alerts to complete the ESF six times a day. Several ESM studies have followed the week-long timeframe, as it provides a comprehensive indication of the habits of the participants' routines (Bailes, 2015). As in this study, I wanted to introduce and explore the element of the musical diet, so it was decided that six days, three of normal and three of no music listening would be optimal. The ESF alerts were scheduled to be sent one every two hours and twenty minutes. Participants could choose the optimal twelve-hour window for their schedule to reduce interference with their everyday life and increase the chances of completing the forms but were not aware of the timing of the two hours. The reason for not following the other studies of ESM and sending random alerts over the pre-set timeframe was that it sought to catch the participants on the same time each day, as the chances of doing something similar depending on their timetable would potentially be higher. The study took place between Thursday and Tuesday. This timeframe was chosen so that there would be an equal number of weekdays and weekend days in each block, and therefore the two blocks would be comparable (Bailes is also incorporating weekend and weekdays in her ESM study, 2006, 2007, 2015).

For the normal music listening block that took place from Thursday–Saturday, participants were asked to follow their music listening routine as usual, except for making sure that the Last.fm Scrobbling app was active. For the second block, which was the musical diet taking place from Sunday–Tuesday, participants were asked to refrain from music listening as much as possible, in reasonable terms: i.e. if they were in an environment that played music and they could not avoid it, they were asked to report this.

All participants completed the blocks in the same order, with the music listening block proceeding the musical diet one. This served the purpose of having the recently listened to music recorded in the first block, so as to investigate the 'recent exposure' argument. The main argument in the INMI literature is that 'earworms' happen after recent or repeated exposure. For this reason, the first block of observation was the music listening one, and the second block the music deprivation. Having the music listening block first enabled the recording of the music listening experience for that timeframe of three days, and provided information on the circumstances of INMI episodes.

5.3.3.1 Material ESF

The ESF comprised four sections: the first was an assessment of current mood in terms of emotional valence and arousal. Russell, Weis, and Mendelsohn's (1989) Valence & Arousal affect grid was transformed for use in Google forms using separate ratings (see Appendix K). It was deliberately set as the first to complete so as to minimise retrospection. This section was mandatory. Next was the section of whether the participants had music in their head or not. If they did have music in their head at that moment, or right before, they would proceed to the rest of the section, which included questions regarding their musical imagery experience, otherwise they would proceed to the next section. This included all musical imagery (MI) experiences, for which then the participant had to give details (voluntary, involuntary etc.). The next section was about music listening: if the participants listened to music at that moment, or shortly before, they would continue completing the details of their music listening. If not, the final section regarding their whereabouts was to be completed to finalise the ESF. Each section had an open comment box regarding that said section, so participants could add comments. The division in sections served to make the ESF as short as possible for the participants and still record data regarding their everyday life (such as activities, whereabouts and affect).

Moreover, to compare the effect of music to that of MI, another separate set of questions was incorporated respectively: how did the music that they listened to make them feel, and how did the music in their head make them feel. These questions were adapted from Sloboda et al. (2001), as other INMI studies have used it successfully (Floridou & Müllensiefen, 2015) and were adjusted for being bipolar, for example, the rating spanning from alert to drowsy, in this one became two ratings: one for each. Similarly, participants had to rate how happy, sad, lonely connected, involved, detached, tense, relaxed, interest and bored they felt. Further inspiration on creating the ESM questionnaire was drawn from North et al. (2004) by utilising their uses and functions of music to create rating categories on what the participants were doing, as well as previous work on experience sampling method studies on everyday life (Krause & North, 2016; Sloboda et al., 2001).

5.3.4 Last.fm

Following Randal and Rickard (2014), an extra step was taken to actually monitor music listening activity. As this study did not have an application, like the one designed for Randal and Rickards's study, a function by the Last.fm website called Scrobbler was utilised, which allows individuals to create and maintain a record of their music listening, which they can also share with their followers. Participants were asked to create an account to the Last.fm website and allow the PI to 'follow' this account. The Last.fm account was synchronised to the preferred music listening device and method: it could be logged in to Spotify and iTunes, as well as YouTube and other listening websites. The Scrobbler had a separate application that had to be open during music listening (unless the Last.fm account was directly logged on into the application, like Spotify) and it also had a browser plug-in utility that could be downloaded, logged in and used to record music listening. As this procedure was new to us as a music listening monitoring tool, participants still had to complete the ESM form regarding their music listening. All participants received further instructions and help on how to download, install, and set up the Scrobbler, and to allow the PI to follow them. After data was collected, the PI unfollowed the participants.

5.3.5 Post-survey

At the end of the study, participants completed a retrospective survey, which asked them to indicate how representative this ESM data collection was, regarding their usual music listening and INMI activity, how difficult it was for them, details regarding the implementation of the musical diet, and their engagement levels with the study. This accounted as an evaluation of the accuracy and validity of the study, and assessed the credibility and the accuracy of the Last.fm tool in terms of recording the music listening.

5.3.6 Participants

Participants were recruited through the University of Sheffield volunteers list and received no compensation in return, but did have the option of obtaining a personalised report, upon request, with their music listening profile after the completion of the study. All normal-hearing and healthy adults were permitted to take part in this study. Individuals were screened for their music listening habits, and their general well-being. Each participant was expected to generate thirty-six reports, (six days of observation, with six ESF each day). Nineteen participants completed the study; the study started with twenty-one participants, but two participants were excluded from the dataset, as they either dropped out or did not fill in more than half of the ESF. Of those nineteen participants, twelve were between the age of eighteen and twenty-five, six were between twenty-six and forty, and one was between forty-one and sixty-five. The majority of the participants self-identified as women (twelve), and six were self-identified as men.

5.3.7 Ethics

The data from the study were kept confidential and anonymous. Only the main researcher had access to the real identities of the participants, and any personal information shared in the forms was used solely for the purposes of analysis. Participants were invited to delete their Last.fm account should they wish to, and the PI 'unfollowed' them after the completion of the study.

5.3.8 Limitations

ESM forms were distributed every two hours and twenty minutes, meaning that after a few alerts, some participants may have noticed the timeframe and have expected it.

Last.fm only records the musical pieces that were listened to either in whole, or at least 50% of the track. That means that several pieces may have fallen under the radar, that could result in later INMI. In fact, hearing only a fraction of a piece that one knows may result in internally hearing the rest of it, if it was indeed a well-known song (Ziegarnik effect, Hyman et al., 2013)

Furthermore, by asking participants about their INMI, INMI may be solicited by the researching process: Hurlburt and Heavey (2015) have explored how an experience sampling method may receive reports that do not reflect the reality of the participants. Their findings suggest that the original, in-the-moment experience is being filtered by the 'presuppositions' of participants, in the sense that participants may have predeterminations and misapprehensions of their reality, that hinders the clear reports, even on ESM studies (Hurlburt & Heavey, 2015).

Lastly, imposing the musical diet might have proven valuable in terms of findings, but nevertheless it limited the record of normal music listening to three days: this may be too small a timeframe to draw reliable conclusions for correlations of music listening and INMI. However, the exploration of the musical diet was deemed more interesting in terms of research: future studies with more days in both conditions may be able to shed a better light onto the situation.

5.4 Results

5.4.1 Pre-screening

The majority of participants (12) had (or were working towards) a postgraduate degree, while six held an undergraduate degree and one was at the level of GCSE or equivalent. The majority of the participants did not consider themselves musicians, with fourteen answering negatively or strongly negatively, four participants answering positively, and one in the middle.

The musical genre that gathered the most reports of preference in the pre-screening survey was Pop (10), with Rock following (9) and Alternative next (8). These were followed by Classical (7), Electronica (6), Jazz (5), Rap/ Hip hop (4) and Soul/Funk (4). Blues and Heavy Metal were preferred by 2, while all other genres had 1 report each (for a more detailed list per participant see Appendix L).

5.4.2 Experience Sampling Forms

5.4.2.1 Experience Sampling Form Data

Several ESM analyses from the literature include quantitative statistical analyses, such as ANOVA (Bailes, 2015) or MANOVA (Krause et al., 2013). However, the objective of this study was to investigate the personalised answers of the participants. Therefore, the analysis is treated similarly to case studies: some general frequencies and tendencies are explored and reported, but the main focus of the results is on personalised uses and differences within the music listening and imagery of each participant. Even though there were 583 reports in total (as seen in more detail below), the study only had 19 participants. This classifies this study as a small-scale study, hindering statistical analysis in certain cases. For example, some participants had as few as only one MI report throughout the study (see Table 5.2), and therefore chi-square tests were not always possible. Nevertheless, detailed reports of frequencies are given, along with some statistical analysis, such as chi-squares and correlations, wherever possible.

There were 583 ESF reports in total, from 684 alerts sent.

Table 5.1 provides an overview of the completion rates per participant, and the number of their reports. Most of the reports included no music listening and no MI (48%, 277 reports). The musical imagery reports were more frequent than the music listening ones, with 205 reports, against 135. This sum is not reflecting a normal situation, as there were only three music listening days, and for the other three, participants were on a musical diet. During the musical diet, some music listening occasions were recorded (39), which is considerably smaller, but nonetheless existent. During the normal listening period, the number of music listening and MI reports were similar (98 for MI and 96 for music listening).

On average, participants reported voluntary or involuntary musical imagery 35% of the time (identical to the finding of Bailes, 2007). The diet days had slightly elevated numbers, with reports of MI being at 37% of all reports, whereas in the normal period the MI reports reached 33%.

The reports of MI were further distinguished into involuntary, voluntary, both or not sure: the INMI accumulated 141 reports in total (69%), 18 reports of solely voluntary MI (9%), 36 of both (18%) and 10 reports of not being sure (5%). The reports were spread equally between the musical diet and non-diet days (INMI non-diet 67, diet 74; MI non-diet 9, diet 7; both involuntary and voluntary musical imagery non-diet 19, diet 17).

The reports for music listening during the normal listening days were of similar frequency with 33%, yet, in the non-listening days, a 14% of music listening was observed. However, some of those reports involved non-chosen music, as seen in Table 5.2, so it is possible that participants had no control over it. Music listening, overall, was mostly self-selected (70.4%). Individual scores vary depending on the participant: some participants did not choose their music listening (such as P14), while others chose it either partially or entirely (P4, P20, P21).

The number of reports including musical imagery varied considerably (as can be expected) across participants from 3.8% of the reports to 78% (see Table 5.2 for individual ratings).

Table 5.1. Completion rates per participant

Codename	Number of completed responses	Percent of total responses	Percentage of completion
1	26	4.5	72
2	35	6	97
3	31	5.3	86
4	26	4.5	72
5	29	5	81
6	33	5.7	92
7	32	5.5	89
8	34	5.8	94
9	36	6.2	100
11	20	3.4	56
12	34	5.8	94
13	36	6.2	100
14	26	4.5	72
15	36	6.2	100
16	31	5.3	86
18	21	3.6	58
19	31	5.3	86
20	30	5.1	83
21	36	6.2	100

Table 5.2, Detailed reports per participant

Codename		1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	18	19	20	21	Total
Reports	Total	26	35	31	26	29	33	32	34	36	20	34	36	26	36	31	21	31	30	36	583
	Normal	14	17	15	14	16	16	17	16	18	12	16	18	15	18	17	8	15	14	18	294
	Diet	12	18	16	12	13	17	15	15	18	8	18	18	11	18	14	13	16	16	18	286
MI	Total	1	10	5	5	16	11	12	5	20	5	4	6	8	6	24	10	20	9	28	205
	Normal	0	4	2	3	9	6	5	2	9	2	3	3	3	2	12	7	9	5	12	98
	Diet	1	6	3	2	7	5	7	3	11	3	1	3	5	4	12	3	11	4	16	107
INMI	Total	0	0	2	4	2	11	11	5	17	5	4	0	8	4	19	7	9	9	24	141
	Normal		0	1	2	2	6	5	2	8	2	3	0	3	0	7	5	6	5	10	67
	Diet		0	1	2	0	5	6	3	9	3	1	0	5	4	12	2	3	4	14	74
Music listening	Total	13	8	3	4	10	6	7	8	7	11	11	8	1	6	5	17	4	1	5	135
	Normal	6	7	3	3	6	5	5	6	6	10	6	7	1	6	5	8	1	1	4	96
	Diet	7	1	0	1	4	1	2	2	1	1	5	1	0	0	0	9	3	0	1	39
Chosen Music Listening	Total	9	2	2	4	7	3	4	4	4	7	9	7	0	5	2	17	3	1	5	95
	Normal	4	2	2	3	5	3	3	3	4	7	4	7	0	5	2	8	0	1	4	67
	Diet	5	0	0	1	2	0	1	1	0	0	5	0	0	0	0	9	3	0	1	28

5.4.2.2 Familiarity, attention, liking and recent exposure

In the 205 MI reports, 194 were stated as having heard that music before, 5 not being sure, and 6 having not heard it before. Moreover, the Mean score of the question of rating how familiar they were with the music in their head, was generally high at 4.17 (SD=1.067, Min=1, Max=5, N=205). There was no difference between the diet or non-diet days (M_{diet}=4.16, SD=1.065, N=107; $M_{non\text{-}diet}$=4.17, SD=1.075, N=98). Regarding familiarity of music listening, the Mean score was similarly high (M_{ML}=4.12, Min=1, Max=5, SD=1.240, N=135) suggesting that participants mostly heard music that they knew. In 107 out of 135 music listening reports, the participants had heard the music before, while in 22 reports they had not, and 4 did not know whether they had or not. Liking of the music ratings regarding music listening reports were even higher, with mean 4.42 (SD=.885, Min=1, Max=5, N=135). The rating of the attention that the participants paid to the music that they listened to was lower, with mean 3.48 (SD=1.257, Min=1, Max=5, N=135). Finally, recent exposure accounted for the majority of MI reports. In the two conditions combined, recent exposure was related to 65% of all INMI; in the normal days, this percentage was higher at 71%, whereas in the diet days, recent exposure was rated at 60%.

Table 5.3 illustrates some correlations between questions regarding music listening (yes or no), and ratings of how pleasant their MI was, how familiar the MI was, how much they liked the MI, if they had recently heard the music from their MI, if they would like to listen to it now, and how much attention they were paying to their MI. The analysis revealed some positive correlations between pleasantness of MI and familiarity with MI (see Table 5.3), and a stronger correlation between liking the music and pleasantness of MI. Equally strong was the correlation between wanting to listen to the music of their MI and pleasantness of said MI. Another moderate correlation was revealed between wanting to listen to the music of their MI and familiarity of MI.

Table 5.3, Correlations of ESF, between Music listening, and recent exposure, liking, familiarity & attention of MI

		Music listening	MI Pleasant	MI Familiarity	MI Liking	MI Recent exposure	MI Listen to now	MI Attention
Music listening	r_s	1	-.11	**-.19****	-.13	**.20**	-.03	**-.16***
	p		.14	**.01**	.06	.00	.63	**.02**
	N	583	205	205	205	205	205	205
MI Pleasant	r_s	-.11	1.00	**.39****	**.67****	-.13	**.69****	**.43****
	p	.14		**<.001**	**<.001**	.07	**<.001**	**<.001**
	N	205	205	205	205	205	205	205
MI Familiarity	r_s	**-.19****	**.39****	1.00	**.64****	**-.15***	**.44****	**.22****
	p	**.01**	**<.001**		**<.001**	**.03**	**<.001**	**<.001**
	N	205	205	205	205	205	205	205
MI Liking	r_s	-.13	**.67****	**.64****	1.00	-.12	**.67****	**.35****
	p	.06	**<.001**	**<.001**		.08	**<.001**	**<.001**
	N	205	205	205	205	205	205	205
MI Recent exposure	r_s	**.20****	-.13	**-.15***	-.12	1.00	-.11	-.10
	p	**<.001**	.07	**.03**	.08		.12	.14
	N	205	205	205	205	205	205	205
MI Listen to now	r_s	-.03	**.69****	**.44****	**.67****	-.11	1.00	**.37****
	p	.63	**<.001**	**<.001**	**<.001**	.12		**<.001**
	N	205	205	205	205	205	205	205
MI Attention	r_s	-.16	**.43****	**.22****	**.35****	-.10	**.37****	1.00
	p	.02	**<.001**	**<.01**	**<.001**	.14	**<.001**	
	N	205	205	205	205	205	205	205
ML Familiarity	r_s	.	**.42***	**.57****	**.64****	-.30	**.45****	.28
	p	.	**.02**	**<.001**	**<.001**	.09	**.01**	.13
	N	135	32	32	32	32	32	32
ML Attention	r_s	.	.31	.19	.18	-.18	.10	**.63****
	p	.	.09	.29	.32	.32	.58	**<.001**
	N	135	32	32	32	32	32	32
ML Liking	r_s	.	**.36***	.33	**.66****	-.29	.33	.27
	p	.	**.05**	.07	**<.001**	.11	.07	.14
	N	135	32	32	32	32	32	32

*. Correlation is significant at the .05 level (2-tailed). **. Correlation is significant at the .01 level (2-tailed).

5.4.2.3 Genre

The relationship of the genre of music listening and the genre of MI was something that this study aimed to examine. However, some issues emerged during the analysis—the main one being that the distinction between the genres can be difficult to determine. Many musical pieces belong to more than one genre, and the classification is vague. Moreover, the participants were classifying the music into genres themselves, and therefore, they were often inaccurate. For example, alternative with indie and rock can often overlap, while pop and r&b or rock also overlap and often the distinction is based on personal opinion. This can lead to misconceptions: if a participant thought that a particular piece was indie, but another might consider it as rock. However, as participants assessed all their music listening and MI episodes individually, by classifying them according to their personal opinion, this problem is somewhat rectified, as those individual reports were compared.

The most frequently reported music listening genre in MI was pop with 24 reports. The most frequently reported MI genre was also Pop with 38 reports. The analysis of the genre and MI that follows is mostly individualised: the correlations and similarities only matter within the music listening of each individual, and while an overview was presented above, the deeper analysis that follows is per participant.

5.4.2.3.1 Genre of music listening and musical imagery, Last.fm records

The data from Last.fm presented a few difficulties in the analysis: the times of the reports for some participants were incongruent to their Last.fm records, despite the fact that the pieces matched—perhaps different time zones would explain these inconsistencies.

However, with tentative examination, the music listening recorded on the Last.fm registers seem to associate with the MI reported by the participants. This effect is particularly prominent in participants with exclusive musical tastes: Participant 5 listened to soundtracks, and has reported MI of a soundtrack (that was not from recent exposure); Participant 13's Last.fm record shows mainly a music listening spectrum of the genres soul, funk, hip hop, alternative and electronica, and their MI is also along these genres; and Participant 20, has almost exclusive music listening in the spectrum of metal (which did not show on their ESFs due to low music listening reports, see Appendix M) and their MI was reportedly also among the same genre.

An interesting finding was on the frequency of music listening: some participants were listening to the same piece for several days.

5.4.2.4 MI and activities

As seen in Table 5.4, the majority of the reports were completed at home, followed by at the university. As most of the participants were students this was expected.

Table 5.4, Location on ESMf

	General	MI only	ML only	MI & ML
Where are you right now	583	173	101	32
Home	366	111	67	25
Work	21	5	2	0
University	132	33	14	7
Transport	23	8	3	0
Car	0	0	0	0
Gym	15	2	5	0
Cafe	20	2	8	1
Friend	9	2	2	0
Shop	8	2	0	0
Concert/cinema/theatre	4	1	1	0
Other	3	1	2	0
Outdoors	21	9	5	0

Subsequently, Table 5.5 shows that most of the reports were filled in while the participants worked or studied, although these terms may overlap with other activities: participants tended to multitask, choosing several activity options for a particular moment.

Table 5.5. Activity on ESMf

	General	Mi only	ML only	Mi & ML
What is your main activity	583	173	101	32
Work/study	200	50	33	15
Housework	15	6	5	0
Travel	23	7	4	0
Walking	28	14	4	0
Cooking	16	7	4	1
Getting ready	44	24	5	5
Self-care	24	6	5	2
Watching TV/movie	43	6	2	0
Read	34	10	1	0
Music	28	0	21	6
Relax	94	37	18	5
Sleep	23	11	0	2
Meditate/ praying	0	0	0	0
Exercise	20	2	6	0
Shop	8	2	0	0
Eat	46	14	12	3
Celebrate	2	0	0	0
Gaming	24	4	5	0
Concert/theatre	0	0	0	0
Phone	7	0	1	0
Procrastinate	18	9	4	3
Romancing	3	1	2	0
Ruminating	4	4	0	0
Socialising	60	15	8	1
Other	37	18	6	2

Table 5.6 and Table 5.7 demonstrate the several significant correlations that were found between music listening and activities: data was recomputed to create new variables that signified Music listening, or Musical Imagery activity when combined with each activity. For example, when an ESMf reported music listening and being in a certain location or activity (see for example in the table below, ML home, indicates a report that included music listening, while the location that was reported was home), then these new variables were correlated accordingly: Musical Imagery vs Music listening. (Please note that there were no reports of music listening for both categories of shopping for both location and activity, so the category is missing for music listening.)

Table 5.6, Correlation including all ESFs on Music listening and Musical Imagery per location

MI / ML		Home	Work	University	Transportation	Gym	Cafe	Friend	Shop	Concert	Other	Outdoors
Home	r_s	.04	-.04	**-.12****	-.05	-.03	-.03	-.03	-.03	-.02	-.02	-.06
	p	.38	.33	**<.001**	.22	.54	.45	.54	.54	.66	.66	.19
Work	r_s	-.04	-.01	-.02	-.01	.00	-.01	.00	.00	.00	.00	-.01
	p	.34	.87	.64	.84	.92	.90	.92	.92	.94	.94	.83
University	r_s	**-.11***	-.02	**.20****	-.02	-.01	**.11***	-.01	-.01	-.01	-.01	-.03
	p	**.01**	.66	**<.001**	.57	.78	**.01**	.78	.78	.84	.84	.55
Transportation	r_s	-.04	-.01	-.02	-.01	.00	-.01	.00	.00	.00	.00	-.01
	p	.34	.87	.64	.84	.92	.90	.92	.92	.94	.94	.83
Gym	r_s	-.05	-.01	-.03	-.01	-.01	-.01	-.01	-.01	.00	.00	-.01
	p	.22	.84	.54	.79	.90	.87	.90	.90	.93	.93	.78
Cafe	r_s	-.07	-.01	.02	-.02	-.01	**.19****	-.01	-.01	-.01	-.01	-.02
	p	.10	.78	.61	.72	.86	**<.001**	.86	.86	.90	.90	.71
Friend	r_s	-.03	-.01	-.02	-.01	.00	.00	.00	.00	.00	.00	-.01
	p	.44	.90	.70	.87	.93	.92	.93	.93	.95	.95	.86
Concert	r_s	-.02	.00	-.01	-.01	.00	.00	.00	.00	.00	.00	-.01
	p	.58	.93	.79	.91	.95	.94	.95	.95	.97	.97	.90
Other	r_s	-.03	-.01	-.02	-.01	.00	.00	.00	.00	.00	.00	-.01
	p	.44	.90	.70	.87	.93	.92	.93	.93	.95	.95	.86
Outdoors	r_s	-.05	-.01	-.03	-.01	-.01	-.01	-.01	-.01	.00	.00	-.01
	p	.22	.84	.54	.79	.90	.87	.90	.90	.93	.93	.78

**. Correlation is significant at the .01 level (2-tailed); *. Correlation is significant at the .05 level (2-tailed); N=583.

Table 5.7. Correlation including all ESFs between Music listening and Musical Imagery per activity

MI / ML		Work study	Travel	Housework	Walking	Cooking	Getting ready	Self-care	TV	Read	Relax	Sleep	Exercise	Eat	Games	Procrastinate	Romancing
Work study	r_s	**.18****	-.03	-.03	-.05	-.04	-.07	-.04	-.03	-.04	-.06	-.05	-.02	-.05	-.03	.04	-.01
	p	**<.001**	.42	.45	.25	.38	.09	.38	.45	.33	.14	.27	.67	.20	.54	.31	.76
Travel	r_s	-.03	-.01	-.01	-.01	-.01	-.02	-.01	-.01	-.01	-.02	-.01	-.01	-.01	-.01	-.01	.00
	p	.48	.83	.84	.75	.81	.65	.81	.84	.79	.58	.76	.91	.73	.87	.77	.93
Housework	r_s	-.03	-.01	-.01	-.02	-.01	-.02	-.01	-.01	-.01	-.03	-.01	-.01	-.02	-.01	-.01	.00
	p	.43	.81	.82	.73	.79	.61	.79	.82	.77	.53	.74	.90	.70	.85	.75	.93
Walking	r_s	-.03	-.01	-.01	-.01	-.01	-.02	-.01	-.01	-.01	-.02	-.01	-.01	-.01	-.01	-.01	.00
	p	.48	.83	.84	.75	.81	.65	.81	.84	.79	.58	.76	.91	.73	.87	.77	.93
Cooking	r_s	-.03	-.01	-.01	-.02	**.15****	-.02	-.01	-.01	-.01	-.03	-.01	-.01	-.02	-.01	-.01	.00
	p	.43	.81	.82	.73	**<.001**	.61	.79	.82	.77	.53	.74	.90	.70	.85	.75	.93
Getting ready	r_s	-.05	-.02	-.01	-.02	-.02	**.27****	**.10****	-.01	-.02	-.04	-.02	-.01	.06	-.01	-.02	-.01
	p	.26	.73	.75	.62	.71	**<.001**	**.02**	.75	.67	.38	.63	.85	.18	.79	.64	.90
Self-care	r_s	-.04	-.01	-.01	-.02	-.01	.05	**.26****	-.01	-.02	-.03	-.02	-.01	-.02	-.01	-.02	-.01
	p	.35	.77	.79	.68	.75	.26	**<.001**	.79	.73	.46	.69	.88	.65	.83	.70	.91
TV	r_s	-.02	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.02	-.01	.00	-.01	-.01	-.01	.00
	p	.62	.88	.89	.83	.87	.75	.87	.89	.85	.69	.83	.93	.81	.91	.84	.95
Read	r_s	-.02	-.01	.00	-.01	-.01	-.01	-.01	.00	-.01	-.01	-.01	.00	-.01	.00	-.01	.00
	p	.72	.91	.92	.88	.91	.82	.91	.92	.90	.78	.88	.95	.86	.93	.89	.97
Relax	r_s	-.04	-.02	-.02	-.03	-.02	-.05	-.02	-.02	-.03	**.11****	-.03	-.01	-.04	-.02	-.03	-.01
	p	.29	.59	.62	.44	.57	.26	.57	.62	.52	**<.01**	.46	.78	.40	.69	.48	.84
Exercise	r_s	-.04	-.01	-.01	-.02	-.01	-.02	-.01	-.01	-.01	-.03	-.02	-.01	-.02	-.01	-.02	.00
	p	.38	.79	.80	.70	.77	.57	.77	.80	.75	.49	.71	.89	.67	.84	.72	.92
Sleep	r_s	-.02	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.02	**.39****	.00	-.01	-.01	-.01	.00
	p	.62	.88	.89	.83	.87	.75	.87	.89	.85	.69	**<.001**	.93	.81	.91	.84	.95
Eat	r_s	-.06	-.02	-.02	-.03	-.02	.01	-.02	-.02	-.02	-.05	-.03	-.01	**.17****	-.01	-.02	-.01
	p	.17	.67	.69	.54	.64	.76	.64	.69	.61	.28	.55	.82	**<.001**	.75	.57	.87
Games	r_s	-.03	-.01	-.01	-.02	-.01	-.02	-.01	-.01	-.01	-.03	-.01	-.01	-.02	-.01	-.01	.00
	p	.43	.81	.82	.73	.79	.61	.79	.82	.77	.53	.74	.90	.70	.85	.75	.93
Procrastinate	r_s	.06	-.01	-.01	-.02	-.01	-.03	-.01	-.01	-.02	-.03	-.02	-.01	-.02	-.01	**.32****	-.01
	p	.14	.77	.79	.68	.75	.54	.75	.79	.73	.46	.69	.88	.65	.83	**<.001**	.91
Romancing	r_s	-.02	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.02	-.01	.00	-.01	-.01	-.01	.00
	p	.62	.88	.89	.83	.87	.75	.87	.89	.85	.69	.83	.93	.81	.91	.84	.95

**. Correlation is significant at the .01 level (2-tailed); *. Correlation is significant at the .05 level (2-tailed). N=5

5.4.2.5 Functions and Mood regulation in MI & music listening

Participants reported music listening helped them very much to change or enhance their mood, entertained them, helped them to pass the time and helped them to feel better. Participants also reported music listening somewhat helped them to focus, and created the right atmosphere.

Not surprisingly, the effect of music listening was stronger with more participants responding 'very much so' instead of 'somewhat' when indicating whether the music listening was changing their mood, was entertaining, helping to pass time, and helping them to feel better. However, even though the effect appeared to be weaker, similar categories emerged in both music listening and musical imagery ratings. Participants frequently experienced the musical imagery as 'somewhat' changing or enhancing their mood, entertaining, accompanying activities, helping to pass time, and helping them to feel better (see Table 5.8 for detailed frequencies).

Neither music listening, nor musical imagery, reportedly, helped the participants socialise.

The categories where musical imagery appears to be different from music listening, are: helping to express emotions and feelings, and helping to escape the reality of everyday. Helping them focus, and helping to create the right atmosphere scores were neutral for MI, whereas music listening was tentatively positive, or positive.

Table 5.8. Frequencies of function ratings of music listening and musical imagery in percentages.

The music:		Not at all	Not very much	Neutral	Somewhat	Very much so
changed or enhanced your mood	ML	5%	6%	18%	**36%**	**36%**
	MI	9%	8%	30%	**45%**	7%
entertained you	ML	4%	5%	16%	34%	**42%**
	MI	8%	4%	17%	**54%**	17%
accompanied your activities	ML	3%	3%	7%	**46%**	42%
	MI	10%	10%	17%	**48%**	15%
helped you socialise	ML	**53%**	13%	22%	10%	2%
	MI	**51%**	22%	20%	6%	1%
helped you to evoke emotions	ML	23%	6%	24%	**27%**	21%
	MI	24%	17%	25%	**29%**	6%
	ML	21%	13%	**34%**	16%	16%

helped you to express your emotions and feelings	MI	**28%**	20%	28%	16%	8%
helped you focus	ML	15%	9%	24%	**35%**	17%
	MI	20%	20%	**37%**	20%	4%
created the right atmosphere	ML	4%	4%	10%	39%	**43%**
	MI	18%	11%	**34%**	30%	7%
helped you to pass the time	ML	13%	4%	10%	**45%**	28%
	MI	15%	8%	23%	**44%**	10%
helped you to feel better	ML	9%	4%	19%	**41%**	28%
	MI	14%	9%	29%	**39%**	9%
helped you to escape the reality of everyday	ML	19%	12%	21%	**24%**	**24%**
	MI	24%	16%	**30%**	23%	7%

N_{ML}= 135; N_{MI}= 205. Bold letters indicate the most frequent ratings.

Both the musical imagery and the music listening made participants most frequently feel alert and happy, which is in line with evidence from other studies (Beaty et al., 2013). Even though the MI did not help participants socialise (Table 5.8), it did not make them feel lonely either (Table 5.9), which suggests that music listening and musical imagery had no effect on social feelings.

The degree to which this happened was, again, slightly stronger for music listening than musical imagery, but the effect of musical imagery seemed otherwise comparable.

Table 5.9. Mood ratings of music listening and musical imagery, in percentages.

How does the music make you feel?		Not at all	Not very much	Neutral	Somewhat	Very much so
Alert	ML	24%	7%	26%	**30%**	13%
	MI	21%	13%	**32%**	28%	6%
Drowsy	ML	**50%**	19%	20%	11%	-
	MI	**45%**	26%	21%	8%	-
Happy	ML	7%	7%	18%	**47%**	22%
	MI	9%	6%	24%	**49%**	12%
Sad	ML	**61%**	13%	13%	10%	2%
	MI	**54%**	23%	16%	7%	1%
Lonely	ML	**56%**	15%	13%	13%	3%
	MI	**59%**	19%	18%	4%	1%
Connected	ML	29%	8%	22%	**30%**	10%
	MI	23%	19%	**33%**	21%	4%
Involved	ML	30%	7%	21%	**31%**	11%
	MI	25%	15%	**34%**	20%	5%
Detached	ML	**47%**	20%	20%	10%	3%
	MI	**48%**	27%	19%	6%	1%
Tense	ML	**54%**	15%	14%	10%	7%
	MI	**62%**	15%	14%	8%	1%
Relaxed	ML	14%	8%	19%	**39%**	19%
	MI	13%	19%	**37%**	24%	7%
Interest	ML	17%	10%	22%	**38%**	13%
	MI	17%	11%	**37%**	30%	5%
Bored	ML	**74%**	15%	10%	1%	-
	MI	**65%**	21%	11%	2%	1%

N_{ML}= 135; N_{MI}= 205. Bold letters indicate the highest rating.

5.4.2.6 Valence and Arousal

Valence and arousal were rated as generally high ($M_{arousal}$= 6.26, SD=1.75, Min=1, Max=9, N=583; $M_{valence}$= 6.46, SD=1.60, Min=1, Max=9, N=583), meaning that participants in general felt energetic and positive. When dividing the dataset based on diet/non-diet days, the diet days had higher Means on both valence and arousal ($M_{Diet\ arousal}$= 6.38, SD=1.71, Min=1, Max=9, N=289; $M_{Diet\ valence}$= 6.57, SD=1.50, Min=1, Max=9, N=289; $M_{Non\text{-}Diet\ arousal}$= 6.14, SD=1.78, Min=1, Max=9, N=294; M Non-

$_{\text{Diet valence}}$= 6.36, SD=1.65, Min=1, Max=9, N=294). Regarding the reports where only MI was reported, the Mean on arousal was the lowest, with 5.94 (SD=1.82, N=173) whereas valence was similar as the other conditions ($M_{\text{MI valence}}$= 6.38, SD=1.5). Figure 5.1 depicts the Mean ratings on arousal, in both normal and diet conditions.

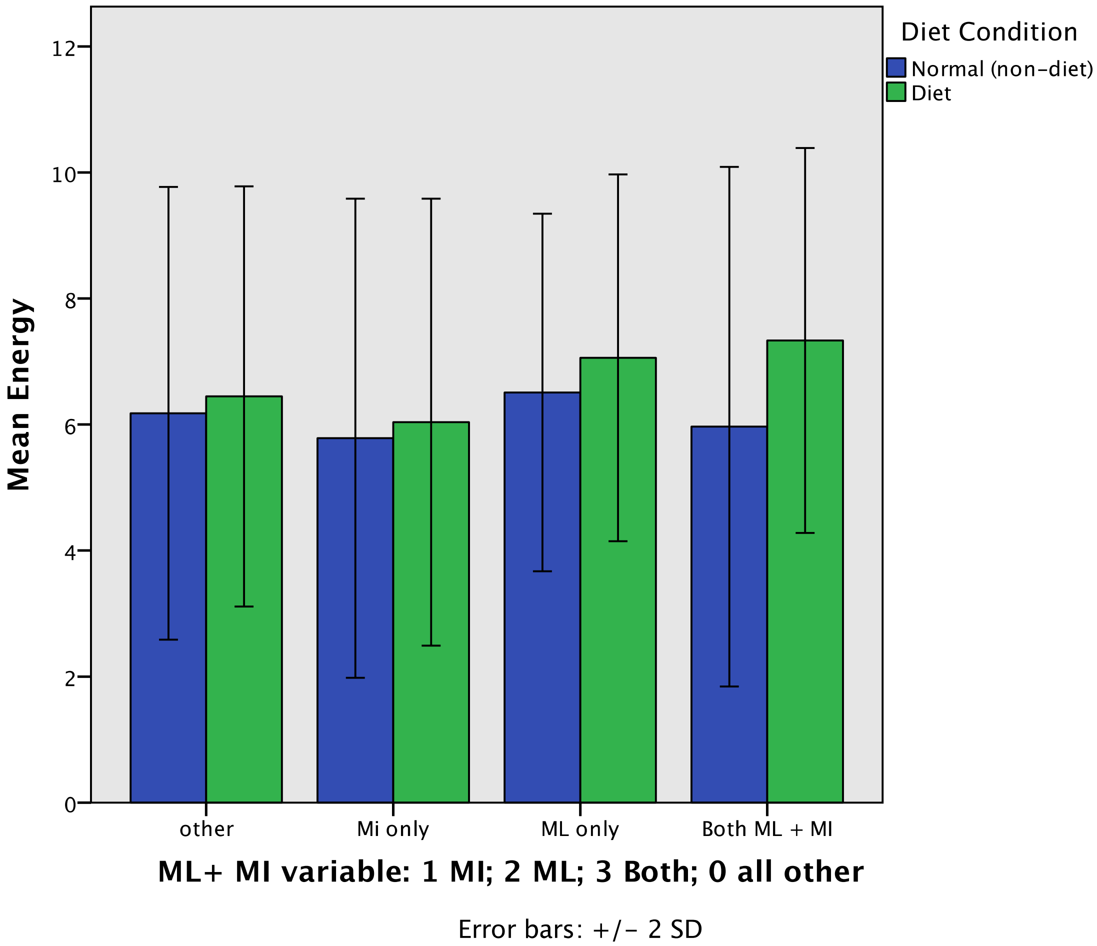

Figure 5.1. Mean of Arousal of Music listening & Musical imagery reports, on normal or diet days

The music listening reports gathered the highest scores on arousal, with no entirely negative answers ($M_{\text{ML arousal}}$= 6.69, SD=1.45, Min=3, Max=9, N=101; $M_{\text{ML valence}}$= 6.63, SD=1.65, Min=2, Max=9, N=101). In reports where both music listening and MI were taking place, valence was the highest of all conditions (M_{arousal}= 6.09, SD=2.04, Min=2, Max=9, N=32; M_{valence}= 6.69, SD=1.67, Min=3, Max=9, N=32). Figure 5.2 represents the Mean ratings of valence, in music listening and musical imagery, for both conditions: normal and diet.

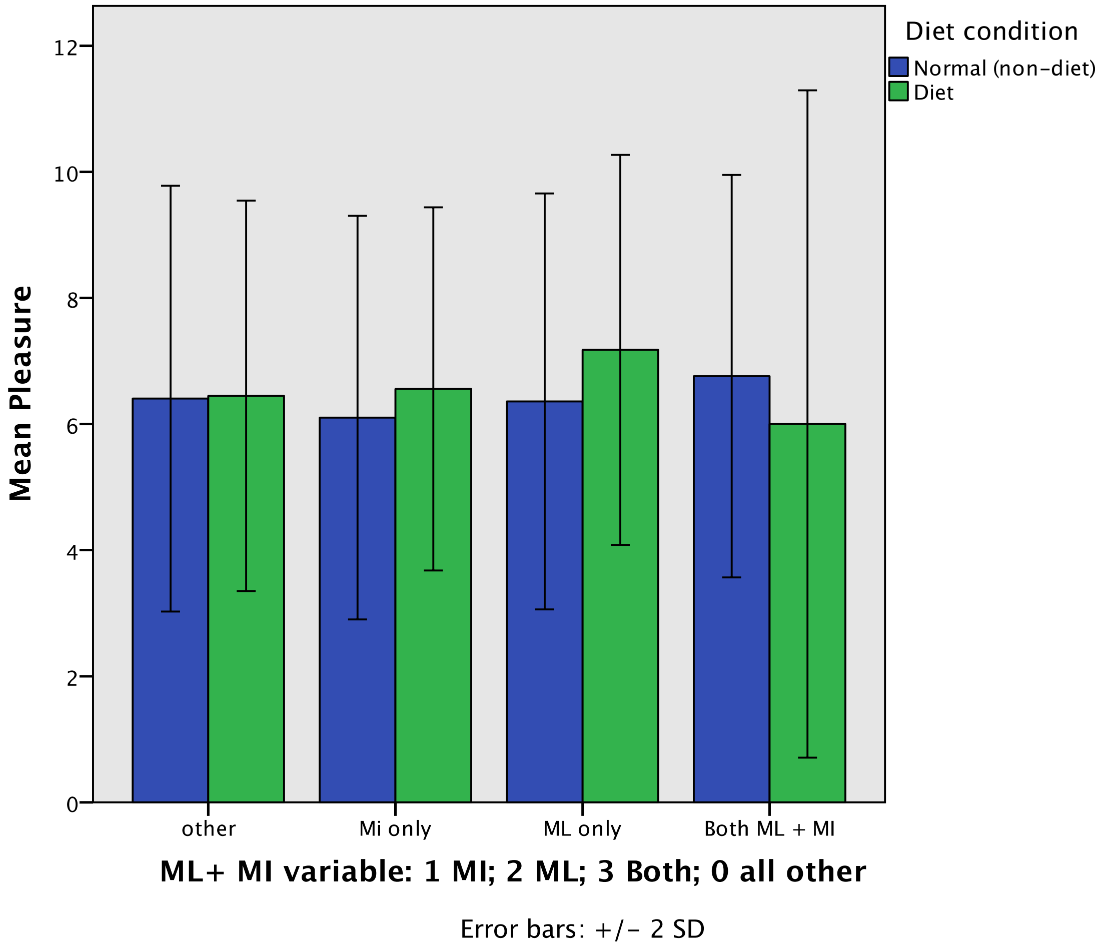

Figure 5.2. Mean of Valence of Music listening & Musical imagery reports, on normal or diet days

5.4.2.7 Personality & music listening/ INMI

One main goal of this study was to investigate similarities and differences between the uses of music and the occasions of INMI, in the scope of personality traits. The data from the ESF did not indicate any similarities on the personality scores and the uses of music while listening to music or having music in one's head.

Data from the ESM reports was aggregated to allow further correlations with the personality scores from the background questionnaire and then the individual Means for the ESM questions for each participant. In all, no significant correlations arose between the ESM music listening and MI reports and the personality scores.

Data from the background questionnaire regarding music listening and INMI was also analysed and some significant correlations emerged. Table 5.10 summarises the significant correlations between the BFI scores and the INMI questions, along with the music listening ones. The conjunction of music listening and INMI was made deliberately to assess the hypothesis that music listening habits may be ‘creating’ INMI occurrences. Data from the background questionnaire do not support this assumption: as seen in Table 5.10, extraversion scores correlate positively with music listening while doing physical activities. INMI ratings while doing physical activities, however, were negatively correlated with extraversion. Openness to experience scores did not correlate with any of the INMI or music listening answers, which is in contradiction with the literature (Wammes & Barušs, 2009).

An additional exploration on the subject of personality, background questionnaire and data from the ESF has been added on to Appendix M.

Table 5.10. Correlations between BFI scores and INMI & music listening scores from Background Questionnaire

		Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
INMI while doing physical activities	r_s	**-.458***	.059	-.361	.323	-.274
	p	.049	.811	.129	.178	.256
INMI does not match my mood	r_s	-.018	**.508***	.365	-.223	-.125
	p	.941	.026	.125	.358	.609
When I get an INMI I mention it to other people	r_s	**.544***	.118	.179	-.254	.204
	p	.016	.631	.464	.294	.403
I usually listen to music as a background	r_s	**.571***	.083	.173	-.126	.004
	p	.011	.735	.48	.608	.986
I can't push my worries aside with the help of music	r_s	**-.622****	-.208	-.038	.248	-.093
	p	.004	.392	.877	.306	.704
When miserable, I listen to music that expresses these feelings	r_s	-.438	**-.481***	**-.575***	**.547***	.13
	p	.061	.037	.01	.015	.596
When everything feels bad, it helps	r_s	-.241	**-.537***	**-.585****	.434	.17
	p	.32	.018	.009	.063	.486

		Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
me to listen to music that expresses my bad feelings						
When angry, I vent by listening to music that expresses my anger	r_s	**-.464*****	-.392	-.304	**.717******	.141
	p	.045	.097	.205	.001	.565
When happy, I feel like listening to happy music	r_s	.083	.498*	.247	-.218	.14
	p	.737	.03	.309	.37	.569
When sad, I feel like listening to sad music	r_s	**-.492*****	**-.507*****	**-.623******	**.714******	.031
	p	.032	.027	.004	.001	.901
I listen to music when I am doing physical activities	r_s	**.574*****	-.152	.297	.046	-.24
	p	.01	.536	.217	.851	.321
I listen to music when I am doing routine activities	r_s	**.627******	.061	.086	-.208	.121
	p	.004	.803	.726	.394	.62
I have very specific musical tastes	r_s	-.31	-.272	.009	**.560*****	.278
	p	.196	.261	.97	.013	.249
I listen to different music in different situations	r_s	**.580******	.149	.205	-.161	.097
	p	.009	.541	.401	.51	.692

N=19. Some questions have been modified here due to limited space. For the full questionnaire list please refer to Appendix I. **. Correlation is significant at the .01 level (2-tailed). *. Correlation is significant at the .05 level (2-tailed).

However, the reports of music listening were very low, and, given the implementation of the musical diet, the music listening data collection period was only three days. There is a possibility that the statistical power was not enough for significant correlations to emerge. In brief, only four significant correlations were found between personality traits and music listening: a positive correlation between the function of self-care while listening to music and extraversion, a negative correlation between listening to music and conscientiousness, and two negative correlations between neuroticism and self-care and relaxation. No significant correlation was found in the functions that have been associated with background music, such as: working, studying, walking, cooking, or exercising.

The correlations between personality and musical imagery yielded more significant relationships, however, no association was found between the frequency of MI and personality, nor recent exposure, pleasantness of MI or liking. (see Table 5.11)

Table 5.11. Correlation of Personality and INMI characteristics, N=19

		Agreeableness	Openness	Extraversion	Conscientiousness	Neuroticism
MI NUM mean	r	-.345	-.167	.27	.141	-.028
	p	.148	.495	.263	.564	.91
Have you heard that music recently	r	-.127	.177	-.085	-.048	.124
	p	.604	.469	.729	.845	.612
How familiar you are with that music	r	.034	-.112	-.042	-.128	-.179
	p	.89	.647	.863	.603	.463
MI want to listen now	r	.082	-.068	-.259	-.022	-.194
	p	.738	.782	.285	.93	.426
How pleasant is having that music in your head	r	.099	-.282	-.201	-.073	-.177
	p	.688	.242	.408	.767	.467
How much you like that music	r	.082	-.063	-.032	-.185	-.282
	p	.739	.799	.897	.449	.242
How much attention you were paying to the music in your head	r	-.062	.082	-.346	.09	.004
	p	.802	.74	.146	.714	.986

The following Table 5.12 illustrates the correlations between the sums of the functions that people combined with music listening, and the five personality traits, calculated by means.

Table 5.12. Correlations between Personality, Music listening and MI

		Agreeableness		Openness		Extraversion		Conscientiousness		Neuroticism	
		ML	MI	ML	MI	ML	MI	ML	MI	ML	MI
Work study	r	-.12	.28	-.31	.05	.23	-.21	.05	-.02	.28	.04
	p	.63	.25	.19	.85	.34	.39	.83	.94	.25	.86
Housework	r	.13	-.23	-.38	-.31	.24	-.25	-.08	**-.53***	-.24	.44
	p	.60	.34	.11	.20	.33	.30	.74	.02	.33	.06
Travel	r	-.16	.08	-.13	.17	-.39	-.30	-.17	-.16	.09	.11
	p	.52	.76	.61	.48	.10	.21	.48	.50	.70	.66
Walking	r	-.19	.33	-.35	.01	-.03	**.49***	.05	.17	.16	-.09
	p	.44	.17	.15	.97	.90	.04	.85	.49	.52	.73
Cooking	r	-.30	-.14	-.18	.09	.08	-.11	-.46	-.19	.16	.03
	p	.21	.56	.47	.72	.75	.66	.05	.45	.51	.89
Getting ready	r	-.17	**.52***	-.04	**.59****	.22	-.06	.06	.37	-.18	-.17
	p	.50	.02	.87	.01	.37	.82	.80	.12	.47	.48
Self-care	r	.40	-.19	.20	.25	.47*	-.17	.15	-.27	**-.54***	-.18
	p	.09	.45	.41	.30	.04	.48	.53	.26	.02	.47
TV	r	-.32	.11	-.30	-.01	.13	**-.50***	-.26	.02	.04	.15
	p	.18	.66	.21	.97	.60	.03	.29	.93	.86	.55
Read	r	.19	.25	-.04	**.46***	.22	-.14	.17	.24	-.30	-.19
	p	.43	.31	.86	.05	.38	.57	.48	.33	.21	.44
Music	r	-.21	-.17	.19	.07	-.32	-.43	**-.58****	-.39	.21	**.48***
	p	.38	.50	.45	.77	.18	.06	.01	.10	.38	.04
Relax	r	.39	.44	-.07	-.05	-.13	-.15	.13	.17	**-.61****	-.24
	p	.10	.06	.78	.85	.60	.55	.60	.49	.01	.33
Exercise	r	.29	.28	.27	.31	.33	-.17	.38	.10	-.32	.13
	p	.22	.26	.27	.20	.17	.49	.10	.68	.18	.60
Sleep	r	.05	.38	.36	.27	-.06	-.03	-.31	**.47***	.00	-.13
	p	.85	.11	.13	.27	.80	.90	.19	.04	1.00	.61
Shop	r	.	-.36	.	.06	.	.28	.	-.09	.	-.11
	p	.	.13	.	.80	.	.24	.	.70	.	.66
Eat	r	-.20	.09	-.39	.21	.21	-.35	-.10	-.22	.14	.19
	p	.41	.72	.10	.39	.38	.14	.69	.38	.57	.45
Games	r	-.38	-.32	.02	-.19	-.37	**-.46***	-.28	-.43	.17	.32
	p	.11	.18	.95	.44	.12	.05	.25	.07	.49	.18
Phone	r	.39	.	.20	.	.00	.	-.04	.	-.37	.
	p	.10	.	.43	.	1.00	.	.86	.	.12	.
Procrastinate	r	-.23	.00	.13	-.01	.17	.26	-.45	-.27	.08	.19
	p	.35	1.00	.59	.98	.48	.28	.06	.27	.75	.44
Romancing	r	.32	-.17	.30	.39	.35	.26	.35	.13	-.26	-.19
	p	.18	.48	.21	.10	.15	.29	.15	.60	.29	.43
Ruminating	r	.	.02	.	-.18	.	-.05	.	-.02	.	.06
	p	.	.94	.	.46	.	.84	.	.93	.	.80
Socialising	r	-.20	.29	-.13	-.03	.08	-.28	-.31	-.17	.44	.10
	p	.41	.22	.60	.90	.74	.24	.20	.49	.06	.69

*Correlation is significant at the .05 level (2-tailed).; **Correlation is significant at the .01 level (2-tailed).

5.4.3 Post-Study Survey

Nineteen participants completed the ESM study, and all of them completed the post-study survey. This survey included ratings on retrospective assessment of the study, how normal and representative of their routine and music listening habits their answers were etc. In detail, the large majority of the participants (84.2%) answered positively (57.9%), or very positively (very much: 26.3%), that the six days' period of the study was representative of their regular routine, with no entirely negative answers (not at all), and only one somewhat negative.

The rated representativeness of the music listening of the participants was also generally positive for the first three days of the study (73.7%), and mixed results for the last three days (52.6% negative, 36.8% positive and 10.5% neutral). Regarding the representativeness of INMI in the first three days of the study, there were only positive answers, with 63.2% reporting being very much representative, and 69.4% regarding the last three days of the study. The assessment of the inclusiveness of the Last.fm spreadsheet was also generally positive, with only two participants answering negatively.

The vast majority of participants agreed that they were engaged with the study (94.7%) and that the questionnaires were easy to access (100%) and the majority found participating in the study not difficult (63.2%). Regarding the musical diet, the majority of participants found it hard to abstain from music (73.7%), while only 42% reported listening to more music after the musical diet was over.

5.5 Discussion

5.5.1 Overall results

During the normal listening days, musical imagery and music listening reports appeared to be equal, which underlines the prevalence of MI in everyday life, as many studies have shown (Bailes, 2007; Liikkanen, 2011; Williamson et al., 2011). However, this level of equality reveals the extent of MI in relation to music listening.

Musical imagery was used for the questionnaire, to ensure that the terms Involuntary Musical Imagery, or 'earworms', would not hinder reports: the previous studies of this thesis have indicated that there might be a level of censorship on what is considered to be an earworm, or INMI, and therefore asking whether the participants had music in their head at that time was an attempt to encourage all reports. The overall levels of MI were identical to findings of Bailes (2007). There was, however, a great variance between the participants, with MI frequencies ranging from 4% to 78% across participants. However, the large majority of the INMI reports regarded either purely involuntary musical imagery (69%), or both voluntary and involuntary (18%), which suggests that the (statistical) majority of the reports of this study refer indeed to INMI.

The implementation of the musical diet was a novel feature of this study. The implementation intended to assess whether a) it would cause elevated MI due to some withdrawal effect, b) it would change the reasons that MI happens, i.e. would recent exposure still be the main reason, and c) it would happen in the absence of music as a coping mechanism.

The MI findings of the diet days showed a slight elevation on the levels of MI, but only by 4%. This number is small, but the ratings were elevated, and it is worth noting that some participants did not commit fully to the musical diet, and that more participants are needed to draw safe conclusions. However, it appears that the musical diet did not make any major difference to the levels of reported MI. The INMI levels in particular, were very similar in the two periods, with the diet period having seven reports more. The after-study survey revealed that participants did not particularly engage in higher music listening than usual after the diet days of the study, showing none of the expected 'withdrawal' symptoms. However, some participants did comment on doing that, so further and lengthier exploration on the effects of music deprivation would be valuable, to assess the individual differences and potential correlations that were not apparent in this study.

Familiarity scores indicate that the participants had mostly heard the music in their head before, with only six reports of not having heard of it before ($N_{ESF\ INMI}$=205), with no difference between the two periods which indicates that there is a relationship with music listening. In accordance with previous literature, being familiar with the music in one's head correlated with pleasantness of the experience, liking the piece they had in their head, and wanting to listen to it (Filippidi & Timmers, 2017). Interestingly, familiarity correlated negatively with music listening and being recently exposed to the music of their MI.

5.5.2 Genre and type of music listening

The genre of both INMI and music listening appeared to be congruent: pop was rated as the most preferred genre in the background questionnaire (by 10 participants), and pop was also the top genre for the reported MI. The correspondence between music listening and MI was particularly apparent in participants with very specific musical tastes in terms of genre—such as participants 5, 18 and 20 (see Appendix L).

One argument might be that MI results were due to the mere fact of recent exposure, which was rated high in both diet and non-diet days. However, if the music listening spectrum of an individual is limited, then the counter argument would be that this is also the music that they soundtrack their everyday life with (Levitin, 2007), and the one that the individuals listen to predominately. This may effectively mean that, in the process of listening to that music, what they do is also conditioning themselves with that music (one example being participant 5 with their musical/soundtrack reports of listening, and unrelated INMI of a musical).

Some participants reported only one genre in the background questionnaire, while others reported several: this limits the comparison. Jakubowski, Finkel, et al.'s (2016) findings of no INMI top charts only underlines the logic between individualised analysis and the complication between music listening of each individual and the genre of their MI.

Moreover, with certain genres there is a great commonality: for example, pop, rock, and alternative music genres often overlap. This was reflected in the reports of the participants as well. Moreover, there are many branches in one genre that have very different characteristics: hard rock with glam rock are quite different sounds. As discussed in the methods, genres are fluid and overlapping: in the cases of the survey, the participants have self-categorised their music, and in the case of Last.fm, the Everynoise website[10] was used for genre classification. That was in many cases subjective and problematic: however, it provided an insight into the music listening of the participants, and even if this was in many ways limited, it opened the field up for further research. Perhaps another method like the mESM app by Randall and Rickard (2013) would not have the same problem, as it would categorise the genres automatically and therefore there would be less researcher or participant bias.

Nevertheless, even when taking all the above considerations into account, data gathering regarding genre offered great information in this study, especially when taking into account the individual reports: since the same person ranked them, some consistency is expected, and it provides a deeper view into the MI's genre, but this time in conjunction with the music listening.

5.5.3 Music and activities

Several similarities between music listening and MI were discovered in terms of activities. What participants were doing while listening to music, significantly correlated with what participants were doing whilst experiencing music in their head in situations like: work or study, cooking, getting ready and during self-care situations (in the shower etc.), trying to sleep, eat, and procrastinating. In terms of location, participants' whereabouts whilst listening to music

[10] http://everynoise.com/engenremap.html

were correlated to their whereabouts whilst having music in their head—with reports of being in the university and in a café. Given that most of the participants were students, the above activities and locations are characteristic of a student lifestyle. This indicates that the activities that participants listened to music to, were also the ones in which they experienced MI. This finding is supporting the hypothesis, and suggests that the ways individuals engage with music, are reflected in their INMI.

5.5.4 Music and mood regulation

The functions of mood regulation for both music listening and MI reports were very similar in terms of categories, with the music listening slightly outranking the musical imagery: music (listening and in their head) helped participants change or enhance their mood, entertained them, accompanied their activities, helped them evoke emotions and helped them feel better. The similarities in the rankings are interesting and indicate the similarities in the ways participants perceived music listening and music in their head. The ways that music listening and musical imagery differed were that, while music listening helped the participants focus, MI was rated as neutral. This is an interesting finding, as contrary to general belief, and older studies (Floridou & Müllensiefen, 2015), MI was not rated negatively on helping to focus: the highest ranking was neutral, with the rest splitting equally between not at all, not very much and somewhat (20 reports each).

5.5.5 Personality

This study aimed to assess whether the previously found correlations of personality and INMI are originating from the uses of music listening of individuals with said personality traits, and it is rather the music listening that leads to the INMI associated with the personality traits. Many studies have investigated the role of personality on music listening (Chamorro-Premuzic et al., 2010; Chamorro-Premuzic, Swami, Furnham, & Maakip, 2009; Chamorro-Premuzic & Furnham, 2007; Schäfer & Mehlhorn, 2017; Vella & Mills, 2017) and musical imagery (Beaty et al., 2013; Floridou et al., 2012; Wammes & Barušs, 2009; Williamson & Müllensiefen, 2012), but these studies have only approached either one at a time, without a deeper investigation on both functions.

There was not any evidence to support or reject this hypothesis: some limited correlations between personality and music listening from the background questionnaire were found, that are not consistent with the literature. The music listening from the ESF correlations were also very limited, but, the small number of reports per participant, plus the musical diet, effectively meant that only three days of regular music listening were recorded, and this may limit the ground for significant correlations. Further personality correlations arose with MI, but no similarities with music listening.

5.5.6 Participation and engagement to the study

Altogether, this study has been easy to participate in, the participants were overall engaged, and the questionnaires were easy to access. This is according to the findings of Randall and Rickard (2013). Their study incorporated a mESM, suggesting that this was easier for participants: the easiness ratings of our participants suggest this too, and was not ranked as difficult. The self-reported engagement of the participants also ranked high. However, an mESM app might have prompted more answers, having an easier to access interface.

5.5.7 Limitations

A small-scale study, with limited participants, and in some cases limited reports, can make the analysis difficult. However, as the point of this study was case-study like, the small number of participants makes it easier to be observed and potentially draw conclusions from. Future studies may explore this link further on a larger scale.

The exploration of the music diet in INMI, further divided the project, with only three days of normal music listening recorded. A future study with more days would potentially reach more reliable conclusions on the effect of the musical diet, and a more in-depth exploration of the music listening habits.

5.5.8 Conclusions

The present study investigated closely the musical element in everyday lives of individuals—that being either music listening or musical imagery. There is tentative evidence for several similarities and a close relationship between music listening and musical imagery: the activities that participants engaged in while listening to music were often the ones where participants had music in their head. Moreover, findings from the genre of music listening and the genre of MI suggest that besides recent exposure, the genre of music listening is often the one that participants choose, and also the one that participants often have in their heads. The hypothesis predicted similarities between the individual uses of music, according to the personality, that would reflect on the reported MI, but no evidence was found to support that notion. However, since the music listening correlations were limited, extra days of observation and more participants would be necessary to draw confident conclusions. The implementation of the musical diet did not yield any significant findings, although the musical imagery reports were slightly elevated during that period. Future studies would be needed to conclude on the effects of the musical diet on INMI, that would allow for more regular music listening observation days. Further enhancement of this study would be an improvement on the method of recording music listening, perhaps with a modified version of Randal and Rickard, being one that incorporates music listening, and giving the option of providing the ESFs. Moreover, more participants would allow for safe conclusions on the matters of music listening, personality and musical imagery. Overall, this study showed certain similarities of music listening and musical imagery, and even though there is not enough evidence to suggest that musical imagery could serve as music listening, there is tentative support for the notion that musical imagery is experienced in a functional context.

6 Music, conditioning, and Involuntary Musical Imagery: a discussion

This chapter will provide a summary of this thesis and its main findings: first, that of the hypothesis with its testable expectations, then the methods with which these expectations were tested, along with their main findings, and a discussion on whether these expectations were met. The chapter concludes with a general discussion concerning the literature on INMI and conditioning theories, and how the findings of the studies meet them, along with a general discussion on INMI, limitations of the present research and premises, and future studies.

6.1 Hypothesis

This thesis proposed that INMI is the conditioned response deriving from a process of conditioning through everyday music listening. As such, being a premise that is very difficult to test in its entirety, it was dispersed into testable predictions, from the basis that the uses of music will define the INMI experience. The first prediction was that INMI will occur in situations where individuals have previously paired them with music. This prediction involved the long-term conditioning effect of participants' music listening habits forming the INMI experiences. The second expectation was that the activities that are paired with music have the potential to create a conditioning link that will be expressed in the form of conditioning. According to this expectation, this link could be recreated in a laboratory environment. The third expectation involved INMI having similar attributes to music listening, and which could potentially act in a similar function: in this example, as a coping mechanism.

The music and activities experiment (Chapter 3) addressed the first and second predictions. By creating a controlled environment where music would be paired with activities, we aimed to investigate whether INMI would occur when the activity would be performed without music. The results were supportive of the hypothesis, as the combined studies yielded a significant correlation of related INMI in the music-related activity as opposed to the podcast condition.

The mood regulation experiment addressed predictions one and three: since individuals used music to regulate their mood, they have created this association (first prediction) and when INMI occurred it had a similar function with music (second prediction) that is acting as a coping mechanism. The results of this study were somewhat inconclusive, as in the initial analysis, stress correlated with INMI for all participants. However, when taking into account the difference of stress levels between the conditions resulting from the experimental manipulation, then the correlation was significant only in the individuals who used music to regulate their stress. Therefore, there was indeed INMI in the place of music which was usually used (to regulate stress).

The third study addressed mainly predictions one and three, by assessing the extent to which music is associated with everyday life, and how this is reflected in the INMI experiences of this individual. However, this study had the potential of examining the hypothesis as a whole, as it allowed for a more rounded investigation: by observing the everyday life music listening and INMI habits of the participants it was possible to discern the individualised patterns that occurred and observe potential correlations between music and INMI. Indeed, the music listening habits of participants were reflected in the INMI reports, in terms of functions (uses of music, activities, and moods) and genre of music.

The hypothesis of this thesis incorporated and utilised the theories of classical conditioning, but as there were no direct measures to examine directly the conditioning hypothesis, this is merely a suggestion rather than a strong claim. The results of this thesis support the claims about conditioning, as this is the theory that appears to be closer to the phenomenon. As discussed in the literature review (Chapter 2), associative learning is key to all learned processes like classical conditioning and operant conditioning (Baddeley, 2013) and implicit learning which is key to priming (McNamara, 2005). However, associative learning appears to be a more conscious process, whereas classical conditioning is not necessarily (Berry, 1997). Conditioning involves associative learning, which with enough repetition becomes an automated process and elicits a new response. This automated process, and the newly-founded response is what distinguishes conditioning from simple associative learning. As having music in one's head is a new response, and an automated one, conditioning seems a plausible explanation.

Priming, on the other hand, is another learned experience, but along with priming comes improvement in the response to the paired stimulus, which is key according to priming theories (McNamara, 2005). As the literature has not confirmed such an improvement, and in fact the evidence points towards being against it: frequent involuntary musical imagery does not correlate with more accurate performance on voluntary musical imagery (Weir et al., 2015).

As argued above and discussed below, the findings of the studies conducted here, whilst not conclusive, are yet supportive to the conditioning hypothesis.

6.2 Empirical studies overview

A series of experiments was designed to address the hypothesis and the expectations: an experiment in which an activity would be systematically paired with music, to evaluate the conditioning effect; a second experiment, in which individuals who use music as a means of stress reduction would be stressed to assess their levels of INMI; and an ESM study that would assess these premises in the everyday lives of individuals. The first two experiments were novel approaches in assessing and inducing INMI in a laboratory-based environment. The Music and Activities study was further divided into two studies: the first study consisted of two days of training, whereas in the second study, the number of training days was increased and a new piece of music was used—one that was rated as 'catchy'.

6.3 Main findings

6.3.1.1 Music and Activities

The first run of the Music and Activities study yielded a significant difference between all three of the test conditions, but not for the music test versus the podcast or silence test individually. INMI from the music used in the experiment (Rel INMI) was significantly higher than having an imagery of the podcast that was used in the experiment, during the Music Test condition, which suggests that the manipulation against the control for the auditory information worked. However, unrelated INMI to the experiment (Unrel INMI) was also significant against the INPod, which suggests that perhaps performing the task itself may have generated the INMI, according to the low attentive states by Williamson et al. (2011), instead of the conditioning.

Nevertheless, Rel INMI had double the reports of Unrel INMI in the Music Test condition, which shows a trend in the direction of the hypothesis. The second study of the Music and Activities study had fewer participants, and the statistical tests did not yield any meaningful analysis. However, the Mean rating of the INMI for the Music Test condition was higher than Study 1, so potentially the new additions improved the design, but, without enough participants, the statistical power of the analysis was low. However, as the two studies were based on the same premise, and used the same questionnaires, there was an extra attempt to combine the two data sets and evaluate that analysis: in the combined dataset, Rel INMI was found to be significantly different from Unrel INMI only during the Music Test condition, which is what the aim of this experiment was. As Rel INMI was not significantly higher in the other conditions, this suggests support for the hypothesis. The effect of Unrel INMI perplexed the results, suggesting that a level of INMI is perhaps to be expected as a baseline in such experiments. The reports of INPod during the first study were also a surprising finding, but they were not replicated in the second study.

6.3.1.2 Mood regulation and INMI

The results of this study were inconclusive. There was no significant difference between the INMI of people who use music to regulate their mood, versus those who do not, nor a difference of INMI across the conditions. However, there is some evidence suggesting that the group of mood-listeners was not homogenously stressed: while the general negative mood ratings suggest that the mood manipulation was successful, this was not equally strong for all participants. After calculating the difference of the negative affect of the test condition, from the negative affect of the baseline rating, the correlation of stress and INMI was possible. Indeed, the difference of the negative affect and the INMI ratings were correlated for the mood-listeners group but not for the non-mood-listeners.

6.3.1.3 Music and INMI in everyday life: an ESM study

This chapter was an exploration of the hypothesis in the everyday life context of individuals. The investigation was set to explore the possibility of the conditioning process that might take place, and was set out to explore links and similarities and differences between music listening and MI, in terms of function, regulation, location, or other characteristics. This study focused on both music listening and MI, with closed and open-ended questions, and also reports on valence and arousal and details of the 'what and where' of the participants which allowed for a wider frame of inspection. Individualised analysis, per participant, allowed for some further conclusions: genre of music listening was mostly related and comparable to genre of MI.

Recent exposure was the main factor for both normal (71%) and diet (60%) period, so there is a decline. It would be interesting to see what that would develop into in a longer diet period, given the fact that the INMI reports actually increased. Effectively, this means that even though recent-exposure-related INMI is still quite prevalent, it is not the main reason why people have INMI.

There was no clear finding of INMI acting as music, but there were findings of INMI serving similar functions: a relationship between music listening and MI was confirmed through several significant correlations of what people were doing when they were listening to music, to what people were doing when experiencing MI. These correlations occurred in the categories of: working or studying, cooking, getting ready, during self-care activities, sleeping, eating and procrastinating. These activities are congruent to the literature of music listening in everyday life (Greasley & Lamont, 2011; North et al., 2004; Sloboda et al., 2001).

Moreover, valence and affect rates were also very similar in music listening and INMI, with slightly weaker ratings on the INMI, which suggests that there is also a relationship of emotional aspect between music listening and INMI.

The genre of the INMI of participants was associated with the genre of reported music listening, and that was especially prominent in individuals with particular music tastes.

6.3.2 Surprising findings

Some unexpected findings emerged from the data of the three studies of this thesis. The first being from the Music and Activities experiment, as, in the design of the study, there was no expectation to have any reports regarding the internal podcast (INPod), yet, during the first round of the experiment there were some reports. I argued that perhaps certain professions that are involved with texts, such as poets or actors, may be more prone to it. Another surprising finding came from the Mood regulation experiment, and that was the significant correlation of negative affect ratings and INMI in the two groups combined: perhaps the significance of this correlation was based on the negative responses, but this may also indicate an error in the classification of the participants as mood-listeners or not. It could also indicate a relationship in general with negative affect and INMI. The findings from both laboratory experiments suggest that there is a baseline of reported INMI from participants, meaning that some participants reported INMI regardless of the manipulation. This finding is in accordance to the literature regarding the prevalence of INMI in everyday life (Liikkanen, 2011) but it is also worthy of further investigation, and something to keep in mind for future experiments inducing INMI. The last unexpected findings were from the ESM study, and it regarded the musical diet: firstly, the musical diet elicited slightly more INMI reports, but only moderately. Secondly, the majority of participants did not report more music listening after the period of the diet, even though it was deemed to be generally difficult to abstain from music completely.

6.4 General thoughts on INMI

6.4.1 Role of attention

Attention is crucial in learning (Le Pelley, Mitchell, Beesley, George, & Wills, 2016) and conditioning (Steele-Russell, Russell, Castiglioni, Reuter, & Van Hof, 2006), therefore, in the hypothesis of this thesis, the level of attention that an individual is paying to the music is potentially the key element in having that music as INMI. The pieces that come later in one's mind, may well be pieces that drew the attention of that person. Attention could be drawn for various reasons: it could be either personal meaning, musical features (Burgoyne et al., 2013), or simple repetition on the radio that led to liking (Hargreaves, 1984). Even if the individual does not remember that they heard it, the mind was attuned to notice, or it could be a fleeting thought (for example, 'oh, they are playing Christmas songs and it is only October', or 'oh, that same song on the radio again'). In situations of everyday music listening, the individual often pays attention to the music, as s/he selects it to serve the purposed function.

6.4.2 Repetition in music and INMI

As seen in the literature, repetition is fundamental in musical structure (Bigand et al., 2005), and an important factor in language acquisition (Baddeley, Gathercole, & Papagno, 1998). ‘Chunking’ fragments of music or speech and repeating them is a common practice in learning (Williamon & Egner, 2004), and there is the argument that this is how memory works (Snyder, 2000). Moreover, repetition is a common practice in music listening, as people repeat music that they like over and over (Conrad, Corey, Goldstein, Ostrow, & Sadowsky, 2018). The inverted-U theories (Chmiel & Schubert, 2017) suggest that familiarity with a piece will affect its liking, and control over the music listening can also determine the pleasantness of the experience.

Taking the above together, the explanation of certain INMI features is logical, since in this hypothesis, it is the music listening that shapes the INMI experiences. Findings from the INMI literature suggest that INMI has the potential to repeat or loop, and it also has the potential to be annoying or pleasant, and specific music often keeps returning as INMI. As seen above, ‘chunking’ as a common practice for learning and memory, as well as the innate repetition in musical structure, can explain the looping effect. Music listening practices can explain the returning INMI. Control over the music, and control over the environment affecting pleasure, can explain annoying and distracting INMI experiences: whilst I argue that it is the individual’s musical experiences that shape their INMI, the individual is not always in control of their musical environment. Several associations may take place at once in everyday life which may trigger INMI, and as congruence to the situation is important for music listening being pleasurable, it seems it is as important to INMI.

One important consideration is that even though this thesis claims that INMI occurs due to previous associations (through the classical conditioning process), new associations can be made each and every day. This means for example, that as involuntary musical imagery is at its core a (musical) memory, the brain will handle it as such, before it can become a conditioned response with systematic repetition. In its initial state however, those musical memories will be governed by the same memory-organisation processes, and memory consolidation in which memories are initially encoded (Dudai, Karni & Born, 2015).

6.4.3 Other elements of INMI

As seen in the literature, INMI is often triggered by certain, extra-musical cues (Williamson et al., 2011); however, there also is strong evidence that music is often the cue to remember past situations (Schulkind et al., 1999). Whilst associations happen naturally, as part of our perception and cognitive functions as humans (Mitchell et al., 2009), the question of why some associations occur rather than others, remains. In that frame, why do we have musical imagery (at least so often) as opposed to other sense-related imagery? Cravings could work similarly: craving for a certain food like chocolate, may, for example, happen due to other associations unrelated to the chocolate per se, such as feelings or situations (Rozin, Levine, & Stoess, 1991). However, one might argue that in food craving and food consumption, there is a difference: the imagery (craving) with the action that supposedly 'caused' it does not match. The action, in the food analogy, involves something we eat or drink. With music, the sensation of listening is very similar when imagined, i.e. music is not something substantial and tangible like food. As seen above, the image of a listening brain and the one that experiences imagery are similar in many ways (Halpern, 2001; Herholz et al., 2012). This could also be the case with visual arts, however, music is again a little different: it is not something one can feel with any other sense (except of course when it is performed). While food and drink cover biological needs, which arguably is essential in a conditioning process, music is not fundamental for survival, as Pinker (1997) argued, and therefore not essential in everyday life; nevertheless, people actively choose to listen to music to accompany their lives. I argue that doing such a systematic practice, paired with an element that has the potential to elicit emotions (Gabrielsson & Bradbury, 2011) and feelings of reward (Menon & Levitin, 2005), does simulate a conditioning process, whereby INMI acquires whichever features music has for the individual.

The findings of the ESM study provide further support to the hypothesis: the literature suggests that recent exposure accounted for the majority of the INMI experiences (Bailes, 2007; Byron & Fowles, 2013; Williamson et al., 2011). Similarly, during the normal music listening period, recent exposure accounted for 71%, whereas during the musical diet, this rate dropped notably to 60% of all INMI experiences, while the INMI reports were slightly higher during the musical diet. This suggests that while recent exposure contributes to having INMI, it is not the main factor in explaining why people have music in their mind. As Filippidi and Timmers's (2017) findings suggest, the type of INMI may depend on musical engagement, with non-musical individuals reporting more negative INMI experiences, that often resulted from recent exposure. More days of musical diet would further decipher INMI experiences and music that was heard recently.

6.5 Limitations of this thesis and of studying INMI

The common limitation on all three studies of this thesis was the small sample size. As the hypothesis suggests that the experience is individualised, it is important to test a large number of participants to draw reliable conclusions. As INMI is an involuntary experience, several thoughts or needs may prevail on the minds of the participants, and it is the statistical power of the majority that can evaluate the overall experience.

Moreover, we are asked to quantify a subjective experience; even in the situation where an episode would be identical between two individuals, there are indications that their opinions (and rating) on it would probably not be identical. Furthermore, one might not notice that their imagery loops for example, or they might not have noticed that they even had imagery. INMI is a subjective experience: an analogy on the rating range may derive from the standard method of doctors rating the pain on a scale of 1–10. On that scale, having a pain rated as 3, evidently shows there is pain. However, it is unclear how the rating is judged for INMI. When would one rate having INMI as a 3 or 4 out of 10? One could have not noticed it, or have judged it to be not persistent nor annoying, leading them to rate it low, or being feebly on in the background. Findings from the Mood Regulation and INMI study, suggest that participants had rated their INMI as low as 2, yet they could still identify a piece, or even a melody. This suggests that even in low ratings, it is not certain what people actually have in their mind: for them, a low INMI rating could be the less persisting kind of INMI, or the one that plays in the background. However, much of the ratings are meant to be subjective: an INMI is annoying only to those who find it annoying, and even though a level of subjective opinion will be present, it is the person who gets to decide if it is pleasant or not. Moreover, if our theory is correct, the person's behaviour and their everyday musical decisions will still be responsible for shaping their INMI experiences. So far, the assessment of INMI relies solely on questionnaires, in one way or another. When the research advances so much so that we can see an INMI on the brain, then perhaps we can have a more educated opinion on how and why it was created, as we will be able to observe the areas which it is associated with.

Perhaps the most important limitation to keep in one's mind is that these observations and this research is based on modern Western culture and its way of life. Different meanings and functions of music will widely affect this hypothesis: its basis being that individuals will have music in their head in whatever way they have been accustomed to receive that information. This theory has also the potential to explain reports of having music in one's head of earlier times, for example in the work of Mark Twain (1876), or in the work of Theodor Reik (1953). Reik attempts a psychoanalytic take on music in the head, where he refers to 'inward singing' as different from a passing thought of a poem, a reference from a scholar of 1876 (Hanslick, 1976 cited on Reik, 1953, p. 10). Reik also discusses the works of Hans Schneider (1863–1906), who reflects that, when music comes into one's mind, it does not come unbidden, but 'because it has been called or revived by something' (Reik, 1953, p. 243). Even in times when music was not that prominent or present in everyday life, music still had the potential to create associations and, according to our hypothesis, these associations have in turn the potential to bring music into one's head. This exploration would be very interesting if it expanded its scope towards different cultures, to individuals who receive and use music differently (Boer & Fischer, 2012), to assess the ways these individuals may have music in their head, and if, indeed, they have music in their heads in the first place.

6.6 Future explorations

As discussed above, this thesis explored the extent to which INMI is a product of a conditioning process through music listening. This was the first attempt to explore this hypothesis and the results are encouraging. Further studies will be able to establish whether this hypothesis is founded, and how it can be used further: for example, the 'Music and Activities' could be developed, by defining the parameters in which this effect can be established, i.e. other parameters that may affect this process, as well as the extent to which they affect it: how much time and intensity of training is needed, the level of attention required during the training, the type of music, and if individual music taste, and/or liking the music play a role. If and when these parameters are defined and established, then this paradigm could be implemented to good use: research has shown that Parkinson's patients who listen to music while walking, overcome the gait effect typical of Parkinson's disease (Bella, Benoit, Farrugia, Schwartze, & Kotz, 2015; Rizzonelli, Kim, Gladow, & Mainka, 2017).

Moreover, if we know why INMI happens, then we can elicit it, for experimental purposes. This effectively would mean that future studies will be able to investigate INMI in the lab (or at least, some aspects of it) and it could be used to introduce brain imaging experiments. So far, there are no real-time imaging of INMI in the brain (to the best of my knowledge) aside from the structural correlational study by Farrugia et al. (Farrugia et al., 2015). Capturing INMI in the brain, and exploring the areas that contribute to the experience and the ways that the brain responds to it, will reveal a great deal about the phenomenon, as we will potentially be able to decipher whether INMI employs different neural networks: for example, the one of implicit or explicit memory (Yang & Li, 2012). Moreover, it would be the first time in the research of INMI, where the questionnaires will be supplementary to the research process, rather than a primary source, since it will be apparent if a participant experiences INMI. [11]

6.7 Conclusions

Overall, this thesis aimed to explore the possibility of a conditioning process between music and everyday life, with INMI being the expression (conditioned response) of this process. Our empirical studies suggest that there is support for the hypothesis, as several expectations were met: the findings of the music and activities experiment, as well as the ESM study, suggest that there is a relationship between the music listening and INMI experiences and indeed there is some evidence that INMI can be conditioned. In terms of how music is used (functions and activities), there is some support that INMI can be a conditioned response, as the mood regulation study's findings suggest that there is a link between using the music in one specific

[11] A first attempt to fMRI experiments investigating INMI has been made by me, during a 5-week internship in Network Neuroscience and Brain Imaging, under the supervision of Dr Robin Wilkins, at the Joint School for Nanoscience and Nanoengineering, at the University of Greensboro, NC, USA in July 2016. The paradigm utilised the self-implemented priming effects: movies have long established the association of music with pictures, and therefore soundtracks are ideal for eliciting INMI (Floridou et al., 2016). By asking the participants about their favourite soundtrack, among other favourite things, and showing a picture of the movie, we elicited INMI without asking the participants for it. This was a small pilot study, so no results are available, but there is good evidence that the paradigm worked, which shows that brain imaging during INMI is imminent.

function (mood regulation) and having INMI with that same function. The ESM study revealed the similarities in music listening and INMI in terms of uses of music and INMI occurrences, functions of music and moods.

All three studies of this thesis were novel and designed to test this hypothesis, however, they could also be utilised in the studying of INMI in general, as the findings, particularly of the two experimental designs, suggest that the experiments did indeed induce INMI. The third study did use a common method to investigate INMI however, and the addition of the musical diet did bring a new knowledge on what happens to INMI without music. As this endeavour was focusing on an involuntary experience, further studies with more participants are needed to clearly confirm this hypothesis, but there is enough evidence from this study that is encouraging. This suggests that we are a step closer to understanding why involuntary musical imagery happens, how music listening can shape this experience, and the fascinating systems of everyday life experiences.

Appendix A

Music and activities (Chapter 3), Study 1, Background Survey

Musical background

Your email address (**ifilippidi1@sheffield.ac.uk**) will be recorded when you submit this form. Not **ifilippidi1**? Sign out
*Required

1. **Participation inform consent** *
   This experiment is exploring the association of music with activities. There are no more risks than the everyday life, in taking part in this study. However should you feel the need, you can withdraw at any given time, with no explanation or further consequences. All data will remain anonymous and strictly confidential.
   Mark only one oval.
   - Agree and proceed

2. **Please insert your initials:** *
   (e.g. if your name is Tom Smith your initials are TS)

3. **I engaged in regular, daily practice of a musical instrument (including voice) for** *
   Mark only one oval.
   - 0 years
   - 1 year
   - 2 years
   - 3 years
   - 4-5 years
   - 6-9 years
   - 10 or more years

4. **If so, in what instrument?**

5. **At the peak of my interest, I practiced daily:** *
Tick all that apply.

- [ ] 0 hrs
- [ ] 0.5 hrs
- [ ] 1 hr
- [ ] 2 hrs
- [ ] 3-4 hrs
- [ ] 5 hrs or more
- [ ] Other: ____________

6. **At the moment I practice daily:** *
(last week's average)
Tick all that apply.

- [ ] 0 hrs
- [ ] 0.5 hrs
- [ ] 1 hr
- [ ] 2 hrs
- [ ] 3-4 hrs
- [ ] 5 hrs or more
- [ ] Other: ____________

7. **I would consider myself a musician** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

8. **I listen attentively to music for:** *
(take for example yesterday and the day before)
Mark only one oval.

- ◯ 0-15 min per day
- ◯ 15-30 min per day
- ◯ 30-60 min per day
- ◯ 60-90 min per day
- ◯ 2 hours per day
- ◯ 2-3 hours per day
- ◯ 4h or more per day

9. **I spend a lot of my free time doing music related activities:** *
(listening, playing, going to concerts, searching for music, reading blogs)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

10. **When I hear a tune I like a lot I can't help tapping or moving to its beat** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

11. **I use music for:** *
Tick all that apply.

- [ ] Mood regulation
- [ ] Entertainment
- [ ] Combining with activities
- [ ] Social
- [ ] Emotion evocation
- [ ] Other: ____________________

12. **On average I have music in my head** *
(any kind of experiencing inner music, based on last week)
Mark only one oval.

- ◯ Less than once per month
- ◯ Once a month or more
- ◯ Once a week or more
- ◯ Once a day
- ◯ More than once a day

13. **The music in my head is always of my musical taste** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

14. **I mostly get annoying and repeated tunes in my head** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

15. **I mostly get fragments of music in my head:** *
(very short and not repeated)
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

16. **I often get emotional while listening to music** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

17. **Music calms and relaxes me** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

18. **I often use music in my everyday life to motivate me** *
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

19. **I usually have music playing in the background while doing other activities** *
(chores, household, exercise etc)
Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

20. **I would consider my self a positive person** *

Mark only one oval.

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agreee

21. **Would you like to add anything else that you find related to your musical background?**

☐ Send me a copy of my responses.

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Appendix B

Music and activities (Chapter 3), Study 1, Task Survey

Tasks

Please answer the questions below as if you see them for the first time

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*Required

1. **Please write the initials of your first and last name, followed by the day of birth** *
   This will be your anonymised coding. For example: John Smith, born on the 5th of July would be JS05

2. **Please write the combination of the session (e.g. music and socks)** *
   (for the control -final- session please enter the combination that was previously e.g. podcast and yarn)

3. **How difficult did you find the task combined with the audio (or silence)?** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Very easy								Very difficult

4. **How well you think your performance was?** *
   (the performance on the task)
   Mark only one oval.

	1	2	3	4	5	6	7	
Very poorly								Very well

5. **How difficult did you find it to concentrate and focus on the task?** *
   Mark only one oval.

	1	2	3	4	5	6	7	
Very easy								Very difficult

6. **Did you enjoy the task?** *
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

7. **Did you pay attention to the sound in the room?** *
(music, or podcast, or silence)
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

8. **Did you enjoy the combination of audio (or silence) and task?** *
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

9. **Did the background audio (or the silence) make the task easier for you?** *
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

10. **Do you think that the combination help you to perform better on the task?** *
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	◯	◯	◯	◯	◯	◯	◯	Very much

11. **How would you describe your mood at the moment?** *
Tick all that apply.

- [ ] Happy
- [ ] Excited
- [ ] Cheerful
- [ ] Relaxed
- [ ] Calm
- [ ] Bored
- [ ] Sad
- [ ] Irritated
- [ ] Tense
- [ ] Neutral
- [ ] Other: ____________

12. **Did the task in combination with the audio (or silence) change your mood?** *
Mark only one oval.

	1	2	3	4	5	6	7	
Negatively	◯	◯	◯	◯	◯	◯	◯	Positively

13. **Were you thinking about something else during the task?** *
Mark only one oval.

◯ Yes
◯ No

14. **If yes, please describe briefly:**

____

15. **I listened to the sounds that were present in the room (the sonic environment)** *
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	◯	◯	◯	◯	◯	◯	◯	Highly applicable

16. **How familiar are you with the auditory information played in this session?** *
(e.g. the music or podcast. for silence, rate 1)
Mark only one oval.

	1	2	3	4	5	6	7	
Not at all	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Very much

17. **I heard, internally, (in my head) speech related to the Podcast that I heard in earlier session** *
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Highly applicable

18. **Did you hear music in your head during the task?** *
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Highly applicable

19. **During the task I heard, internally, the same music that I heard in earlier session** *
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Highly applicable

20. **During the task I heard music in my head, unrelated to the music heard in earlier session** *
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Highly applicable

21. **If yes, please describe briefly:**

22. **Do you hear music in your head now? ***
(On the scale below, please rate how appropriate do you feel the statement is for you:)
Mark only one oval.

	1	2	3	4	5	6	7	
Not applicable	○	○	○	○	○	○	○	Highly applicable

23. **If yes, please describe briefly:**

24. **Do you hear anything else inside your head now? ***
Mark only one oval.

- Yes
- No

25. **Did you have the music from the experiment in your head at any point after the experiment? ***
This is only applicable after the first session, on the second and third day of the experiment.
Mark only one oval.

- Yes
- No

26. **If the answer above is yes, please elaborate.**
when/where it happened, what you were doing/thinking, any other thoughts/associations you may feel that are related

27. **Do you have any comments on the task or the combination?**

☐ Send me a copy of my responses.

Appendix C

Background Survey for studies: Music and activities (Chapter 3), Study 2; Mood Regulation and INMI (Chapter 4)

Prescreening questionnaire

Please read the following questions and indicate whether you agree with each statement. If you disagree with any of the terms then the questionnaire will be terminated. If you have any questions regarding this project, please email ifilippidi1@sheffield.ac.uk

*Required

1. **Email address** *

2. **I confirm that I have read and understand the information provided concerning the research project and I have had the opportunity to ask questions about the project. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences.** *
   Tick all that apply.
   - [ ] Yes

3. **I understand that my responses will be kept strictly confidential and that my name will not be linked with the research materials, nor I will be identified or identifiable in the report or reports that result from the research. I agree for the data collected from me to be used in future research and I give permission for members of the research team to have access to my anonymised responses.** *
   Tick all that apply.
   - [ ] Yes

4. **I agree to take part in the current research project.** *
   Mark only one oval.
   - ( ) Yes
   - ( ) No *Stop filling out this form.*

Music listening

Please try and think of your listening habits- for example try and think about your listening patterns over the last 2 days.

5. **I listen attentively to music for** *
(take for example yesterday and the day before)
Mark only one oval.

- 0-15min per day
- 15-30 min per day
- 30-60 min per day
- 60-90 min per day
- 1.5-2 hrs per day
- 2-3 hrs per day
- 4hrs or more
- Other: ____________

6. **I use music:** *
click all that apply
Tick all that apply.

- [ ] to change or enhance my mood
- [ ] for entertainment
- [ ] accompanying activities
- [ ] for social reasons
- [ ] to evoke emotions
- [ ] Other: ____________

7. **I listen to music to make cleaning and other housework more pleasant** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

8. **I usually put background music on to make the atmosphere more pleasant** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

9. **I usually listen to music as a background, while doing other activities** *
(chores, household, exercise, driving)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

10. **When I'm going out (for example for classes, hobbies, or a party), I listen to music to get myself in the right mood** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

11. **When I'm tired out, I rest by listening to music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

12. **Listening to music doesn't help me to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

13. **I mostly use music to relax and unwind** *
(as oppose to doing other things to relax)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

14. **I use another method (other than music) to relax:**
please describe

____

15. **When I'm exhausted, I listen to music to perk up** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

16. **I listen to music to get a breathing space in the middle of a busy day** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

17. **When I'm feeling sad, I listen to music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

18. **Listening to music helps me to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

19. **Music does not evoke strong emotional experiences in me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

20. **I like to listen to music that evokes feelings in me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

21. **When I feel bad, I try to get myself in a better mood by engaging in some music-related activity** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

22. **I can't push my worries aside with the help of music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

23. **When everything feels miserable, I start to listen to music that expresses these feelings** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

24. **When everything feels bad, it helps me to listen to music that expresses my bad feelings** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

25. **When I get angry, I give vent to my anger by listening to music that expresses my anger** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

26. **Listening to music takes me back and gets me thinking about different things that have happened to me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

27. **When I'm really happy, I feel like listening to some happy music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

28. **When I'm really sad, I feel like listening to some sad music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

29. **Listening to music doesn't comfort me in my sorrows** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

30. **I mostly listen to music when I'm doing physical activities such as exercise, walking, or cycling** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

31. **I mostly listen to music when I'm doing engaging mental activities such as reading or writing** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

32. **I mostly listen to music when I'm doing routine activities such as housework, cleaning, or brushing my teeth** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

33. **In a stressful situation I listen to music to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

34. **I have very specific musical tastes** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

35. **I listen to different music in different situations** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

36. **I don't really care what I'm listening to, it's usually in the background** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

37. **If you have any comments or would like to share something related to your music listening please do so below:**

Earworms

Earworms is the name for the experience of having music in your head, without actual music playing. This can loop and repeat, or it can just play for a while (or even once) and then stop. You might have heard it recently, or can't remember when you heard it last. Earworms can be pleasant, or annoying.

38. **I often have music in my head (earworms)** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

39. **My earworms are mostly of my musical taste** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

40. **I get the same earworm coming back again and again** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

41. **I find it difficult to get rid of my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

42. **Earworms help me when I'm trying to get things done** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

43. **It worries me when I have an earworm stuck in my head** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

44. **I find my earworms irritating** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

45. **I am usually unaware of what caused my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

46. **I try to work out what might have triggered my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

47. **Hearing music triggers my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

48. **Personal issues trigger my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

49. **My earworms are triggered when I think about past events** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

50. **My earworms bring back past emotional associations** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

51. **I get earworms when I’m doing physical activities such as exercise, walking, or cycling** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

52. **I get earworms when I’m doing engaging mental activities such as reading or writing** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

53. **I get earworms when I’m doing routine activities such as housework, cleaning, or brushing my teeth** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

54. **Words that I hear or read trigger my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

55. **My earworms don't necessarily match my mood** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

56. **My earworms are not as vivid as hearing real music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

57. **I don’t like the music I have as earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

58. **I like my earworms** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

59. **When I get an earworm I try to manipulate it in my head** *
(e.g., make it play to the end, fill in musical details)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

60. **When I get an earworm I mention it to other people around me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

61. **My earworms contain music that I have never heard before** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

62. **The earworms I get are from styles of music to which I would not normally choose to listen** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

63. **My reaction to an earworm is to listen to/ sing/ hum/play the imagined music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

64. **In my life, there have been times when I've had earworms more frequently and times when they were less frequent** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

65. **I enjoy earworms as much as listening to actual music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

66. **I get earworms when I would like to listen to music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

67. **If you have any comments or would like to share something related to your earworms please do so below:**

Personal information

(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)

68. **I engaged in regular, daily practice of a musical instrument (including voice) for** *
Mark only one oval.

- 0 years
- 1 year
- 2-4 years
- 5-7 years
- 7-9 years
- 10 or more years

69. **If so, in what instrument?**

____

70. **At the peak my interest, I practiced daily:**
Mark only one oval.

- 0-0.5hrs
- 1-2 hrs
- 3-4 hrs
- 5hrs or more
- Other: _______________________

71. **At the moment I practice daily:**
(last week's average)
Mark only one oval.

- 0 hrs- 0.5hr
- 0.5- 1hr
- 1-2hrs
- 3-4hrs
- 5hrs or more
- Other: _______________________

72. **I would consider myself a musician** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

73. **I spend a lot of my time doing music related activities:** *
(listening, playing, going to concerts, searching for music, reading blogs)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

74. **What is your age?** *
(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)
Mark only one oval.

- 18-25
- 26-40
- 41-65
- over 65
- prefer not to say
- Other: ____________

75. **Please indicate your highest level of formal education attained (or which you are currently in the process of studying for).**
Mark only one oval.

- No formal education
- GCSE or equivalent
- A-level or equivalent
- Undergraduate or equivalent
- Postgraduate or equivalent

76. **Please write your nationality** *

____

77. **Please tell us if english is your first language** *
Mark only one oval.

- Yes
- No
- Prefer not to say

78. **What is your gender** *
(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)
Mark only one oval.

- Female
- Male
- Prefer not to say

79. **Have you ever been diagnosed by a mental health professional with depression or other mental illness?** *
(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)
Mark only one oval.

- Yes
- No
- Prefer not to say

Thank you for your participation

- [ ] Send me a copy of my responses.

Appendix D

Mood Regulation and INMI (Chapter 4), PANAS Baseline Survey

Please tell us how you feel NOW

This section is for you to describe your mood now.

*Required

1. **Email address** *

2. **Please write the initials of your first and last name, followed by the day of birth** *
   example: John Smith, born on the 5th of July would be JS05

3. **Interested** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

4. **Upset** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

5. **Excited** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

6. **Distressed** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

7. **Strong** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

8. **Guilty** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

9. **Scared** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

10. **Hostile** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

11. **Enthusiastic** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

12. **Irritable** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

13. **Alert** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

14. **Ashamed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

15. **Inspired** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

16. **Nervous** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

17. **Determined** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

18. **Attentive** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

19. **Jittery** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

20. **Active** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

21. **Afraid** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

Please tell us how you felt in the PAST WEEK

This section is for us to describe (approximately) how you felt in the past week.

22. **Interested** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

23. **Upset** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

24. **Excited** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

25. **Distressed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

26. **Strong** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

27. **Guilty** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

28. **Scared** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

29. **Hostile** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

30. **Enthusiastic** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

31. **Irritable** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

32. **Alert** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

33. **Ashamed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

34. **Inspired** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

35. **Nervous** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

36. **Determined** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

37. **Attentive** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

38. **Jittery** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

39. **Active** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

40. **Afraid** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

Please tell us how you felt in the PAST YEAR

This section is for us to describe (approximately) how you felt in the past year, meaning in general.

41. **Interested** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

42. **Upset** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

43. **Excited** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

44. **Distressed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

45. **Strong** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

46. **Guilty** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

47. **Scared** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

48. **Hostile** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

49. **Enthusiastic** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

50. **Irritable** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

51. **Alert** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

52. **Ashamed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

53. **Inspired** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

54. **Nervous** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

55. **Determined** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

56. **Attentive** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

57. **Jittery** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

58. **Active** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

59. **Afraid** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

☐ Send me a copy of my responses.

Appendix E

Mood Regulation and INMI (Chapter 4), INMI Survey

Earworms

Earworms is the experience of having music in your head, without listening to actual music

*Required

1. **Please write the initials of your first and last name, followed by the day of birth** *
   example: John Smith, born on the 5th of July would be JS05

2. **Do you have earworms now?** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

3. **Are you enjoying having music in your head now?**
   If you don't have any music in your head just leave this blanc.

4. **Can you identify the piece, which is it?**
   If you don't have any music in your head just leave this blanc.

5. **Is this music that you would normally listen to?**
   If you don't have any music in your head just leave this blanc.

6. **Do you enjoy listening to that type of music?**
   If you don't have any music in your head just leave this blanc.

7. **In which occasions would you pick this music?**
   Name the last one. If you don't have any music in your head just leave this blanc.

8. **How does this music make you feel?**
   If you don't have any music in your head just leave this blanc.

9. **Do you find it annoying?**
   If you don't have any music in your head just leave this blanc.
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

10. **Do you have anything else you would like to add regarding your earworms now?**
    If you don't have any music in your head just leave this blanc.

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Appendix F

Mood Regulation and INMI (Chapter 4), Experiment Survey

Experiment questionnaire

This is an estimation of your mood, so please don't overthink or over analyse the questions.

*Required

1. **Email address** *

2. **Please write the initials of your first and last name, followed by the day of birth** *
   example: John Smith, born on the 5th of July would be JS05

3. **Please pick the condition you just participated in** *
   Tick all that apply.
   - [ ] Mock Interview
   - [ ] Alone in room

Please rate how you feel NOW

This is an estimation of your mood, so please don't overthink or over analyse the questions.

4. **Interested** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

5. **Upset** *
   Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

6. **Excited** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

7. **Distressed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

8. **Strong** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

9. **Guilty** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

10. **Scared** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

11. **Hostile** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	( )	( )	( )	( )	( )	Strongly Agree

12. **Enthusiastic** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

13. **Irritable** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

14. **Alert** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

15. **Ashamed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

16. **Inspired** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

17. **Nervous** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

18. **Determined** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

19. **Attentive** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

20. **Jittery** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

21. **Active** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

22. **Afraid** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

Please tell us how you felt DURING the experiment.

This is an estimation of your mood, so please don't overthink or over analyse the questions.

23. **Interested** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

24. **Upset** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

25. **Excited** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

26. **Distressed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

27. **Strong** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

28. **Guilty** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

29. **Scared** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

30. **Hostile** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

31. **Enthusiastic** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

32. **Irritable** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

33. **Alert** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

34. **Ashamed** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

35. **Inspired** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

36. **Nervous** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

37. **Determined** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

38. **Attentive** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

39. **Jittery** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

40. **Active** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

41. **Afraid** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly Agree

This page is about what you think of NOW

42. **Are you thinking of something other than the experiment?** *
If yes please describe briefly.

43. **Are you happy with your mood now?** *
Mark only one oval.

	1	2	3	4	5	
Mostly disagree	◯	◯	◯	◯	◯	Mostly agree

44. **Would you like to change your mood?** *
Mark only one oval.

	1	2	3	4	5	
Mostly disagree	◯	◯	◯	◯	◯	Mostly agree

45. **If above answer is positive, please describe the way that you would attempt to change your mood now.**
i.e. what you would be rather doing now

46. **I am experiencing InMI now** *
(I have music playing in my head)
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

47. **If previous answer is yes, or not sure, please elaborate**
If you do have music in your head, please explain, what it is, if it's to your taste, if it's pleasurable/annoying, if and when you would normally listen to that type of music, and how it makes you feel.

This page is about what you thought DURING the experiment

48. **Were you thinking of something other than the experiment?** *
If yes please describe briefly.

49. **Were you happy with your mood during the experiment?** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

50. **Would you like to change your mood?** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

51. **If above answer is positive, please describe the way that you would attempt to change your mood now.**
i.e. what you would be rather doing now

52. **Did you experience InMI during the experiment?** *
Having music in your head in the condition you JUST participated
Mark only one oval.

- Yes
- No
- Not sure

53. **If previous answer is yes, or not sure, please elaborate**
If you do have music in your head, please explain, what it is, if it's to your taste, if it's pleasurable/annoying, if and when you would normally listen to that type of music, and how it makes you feel.

This page is about what you thought DURING the experiment

54. **I did not feel threatened by the situation** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

55. **The situation was important to me** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

56. **In this situation I knew what to do** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

57. **The outcome of the situation mainly depended on me** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

58. **I knew what I had to do to influence the past situation.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

59. **I was able to do something to influence the course of the previous situation.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

60. **I did not care about the situation** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

61. **I had no idea what I should do** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

62. **I did not feel worried because the situation did not represent any threat for me.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

63. **The situation was not a challenge** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

64. **In this situation I could think of lots of action alternatives.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

65. **I was able to determine a great deal of what happened in this situation myself.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

66. **This situation scared me.** *
Please answer only for the condition you JUST participated.
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

67. **This task challenged me.** *

Please answer only for the condition you JUST participated.

Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

☐ Send me a copy of my responses.

Appendix G

Mood Regulation Regulation and INMI (Chapter 4), Mock Interview Job descpription

A secretary or administrator provides both clerical and administrative support to professionals, either as part of a team or individually. The role plays a vital part in the administration and smooth-running of businesses throughout industry.

Secretaries/administrators are involved with the coordination and implementation of office procedures and frequently have responsibility for specific projects and tasks and, in some cases, oversee and supervise the work of junior staff.

Responsibilities

- letter writing;
- dealing with telephone and email enquiries;
- creating and maintaining filing systems;
- scheduling and attending meetings, creating agendas and taking minutes—shorthand may be required;
- keeping diaries and arranging appointments;
- using a variety of software packages, such as Microsoft Word, Outlook, PowerPoint, Excel, Access, etc., to produce correspondence and documents and to maintain presentations, records, spreadsheets and databases;
- using content management systems to maintain and update websites and internal databases;
- managing and maintaining budgets, as well as invoicing;
- ordering and maintaining stationery and equipment;
- photocopying and printing various documents, sometimes on behalf of other colleagues;
- recruiting, training and supervising junior staff and delegating work as required;
- manipulating statistical data;
- arranging in-house and external events.

Skills. You will need to have:

- strong organisational skills;
- presentation skills and attention to detail;
- the ability to plan your own work, work on your own initiative and meet deadlines;
- the ability to manage pressure and conflicting demands and prioritise tasks and workload;
- oral and written communication skills;
- tact, discretion and respect for confidentiality;
- a pleasant, confident telephone manner;
- teamwork;
- reliability and honesty;
- project management skills.

Appendix H

Mood Regulation Regulation and INMI (Chapter 4), Interview Questions

1. How did you find the experiment?

2. Were you focused on the tasks, or were you distracted? Mind wandering?

3. Was it stressful? Did you feel stressed in the interview condition?

4. Were there any differences between the conditions?

5. Were you able to calm yourself—if stressed—, after the interview condition?

6. Did you have any music in your head at all during the session? (more details if this is positive)

7. Did you think of music during the session? Did you think of hearing music? (more details if this is positive)

8. Would you use music to calm down, in a similar situation? Or it would stress you more? (more details if this is positive)

9. Do you have any idea what this experiment is about?

10. Do you have something else you would like to add?

Appendix I

INMI in everyday life, an ESM study (Chapter 5), Background Form

Prescreening questionnaire

Please read the following questions and indicate whether you agree with each statement. If you disagree with any of the terms then the questionnaire will be terminated. If you have any questions regarding this project, please email ifilippidi1@sheffield.ac.uk

*Required

1. **Email address ***

2. **I confirm that I have read and understand the information provided concerning the research project and I have had the opportunity to ask questions about the project. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. ***
   Tick all that apply.
   - [ ] Yes

3. **I understand that my responses will be kept strictly confidential, that my responses will be anonymised before analysis, and that my name will not be linked with the research materials, nor I will be identified or identifiable in the report or reports that result from the research. I agree for the data collected from me to be used in future research and I give permission for members of the research team to have access to my anonymised responses. ***
   Tick all that apply.
   - [ ] Yes

4. **I agree to take part in the current research project. ***
   Mark only one oval.
   - ◯ Yes
   - ◯ No *Stop filling out this form.*

Music listening

Please try and think of your listening habits- for example try and think about your listening patterns over the last 2 days.

5. **I listen attentively to music for** *
(take for example yesterday and the day before)
Mark only one oval.

- 0-15min per day
- 15-30 min per day
- 30-60 min per day
- 60-90 min per day
- 1.5-2 hrs per day
- 2-3 hrs per day
- 4hrs or more
- Other: ____________________

6. **I use music:** *
click all that apply
Tick all that apply.

- [ ] to change or enhance my mood
- [ ] for entertainment
- [ ] accompanying activities
- [ ] for social reasons
- [ ] to evoke emotions
- [ ] to express my emotions and feelings
- [ ] to help me focus
- [ ] to create the right atmoshpere
- [ ] to pass the time
- [ ] to make me feel better
- [ ] to escape the reality of everyday
- [ ] Other: ____________________

7. **I use music:** *
   click all that apply
   Tick all that apply.

- [ ] to change or enhance my mood
- [ ] for entertainment
- [ ] accompanying activities
- [ ] for social reasons
- [ ] to evoke emotions
- [ ] to express my emotions and feelings
- [ ] to help me focus
- [ ] to create the right atmoshpere
- [ ] to pass the time
- [ ] to make me feel better
- [ ] to escape the reality of everyday
- [ ] Other: ______________________

8. **The genre I mostly listen to is:** *
   please click the one that you mostly listen to, unless your preference is equal.
   Tick all that apply.

- [ ] Alternative
- [ ] Blues
- [ ] Classical
- [ ] Country
- [ ] Electronica/dance
- [ ] Folk / Traditional
- [ ] Heavy metal
- [ ] Jazz
- [ ] Pop
- [ ] Rap / hip-hop
- [ ] Religious
- [ ] Rock
- [ ] Soul/ Funk
- [ ] I'd rather not say
- [ ] I don't agree with genres classification
- [ ] Other: ______________________

9. **I listen to music to make cleaning and other housework more pleasant** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

10. **I put background music on to make the atmosphere more pleasant** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

11. **I usually listen to music as a background, while doing other activities** *
(chores, household, exercise, driving)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

12. **When I'm going out (for example for classes, hobbies, or a party), I listen to music to get myself in the right mood** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

13. **When I'm tired out, I rest by listening to music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

14. **Listening to music doesn't help me to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

15. **I use music to relax and unwind** *
(as oppose to doing other things to relax)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

16. **I use another method (other than music) to relax:**
please describe

____

17. **When I'm exhausted, I listen to music to perk up** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

18. **I listen to music to get a breathing space in the middle of a busy day** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

19. **When I'm feeling sad, I listen to music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

20. **Listening to music helps me to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

21. **Music does not evoke strong emotional experiences in me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

22. **I like to listen to music that evokes feelings in me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

23. **When I feel bad, I try to get myself in a better mood by engaging in some music-related activity** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

24. **I can't push my worries aside with the help of music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

25. **When everything feels miserable, I start to listen to music that expresses these feelings** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

26. **When everything feels bad, it helps me to listen to music that expresses my bad feelings** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

27. **When I get angry, I give vent to my anger by listening to music that expresses my anger** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

28. **Listening to music takes me back and gets me thinking about different things that have happened to me** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

29. **When I'm really happy, I feel like listening to some happy music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

30. **When I'm really sad, I feel like listening to some sad music** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

31. **Listening to music doesn't comfort me in my sorrows** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

32. **I listen to music when I’m doing physical activities such as exercise, walking, or cycling** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

33. **I listen to music when I’m doing engaging mental activities such as reading or writing** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	⬭	⬭	⬭	⬭	⬭	Strongly agree

34. **I listen to music when I'm doing routine activities such as housework, cleaning, or brushing my teeth** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

35. **In a stressful situation I listen to music to relax** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

36. **I have very specific musical tastes** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

37. **I listen to different music in different situations** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

38. **I don't really care what I'm listening to, it's usually in the background** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

39. **If you have any comments or would like to share something related to your music listening please do so below:**

____

____

____

____

____

Involuntary Musical Imagery (INMI)

Involuntary musical imagery (INMI) is the name for the experience of having music in your head unsolicited, without actual music playing. This can loop and repeat, or it can just play for a while (or even once) and then stop. You might have heard it recently, or can't remember when you heard it last. INMI can be pleasant, or annoying or even something in between. Please think of how the experience is like for you when answering the questions below.

40. **I often have music in my head (INMI)** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

41. **My INMI is of my musical taste** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

42. **I get the same INMI coming back again and again** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

43. **I find it difficult to get rid of my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

44. **INMI helps me when I'm trying to get things done** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

45. **It worries me when I have INMI stuck in my head** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Always

46. **I find my INMI irritating** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

47. **I am unaware of what caused my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

48. **I try to work out what might have triggered my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

49. **Hearing music triggers my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

50. **Personal issues trigger my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

51. **My INMI is triggered when I think about past events** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

52. **My INMI brings back past emotional associations** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

53. **I get INMI when I’m doing physical activities such as exercise, walking, or cycling** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

54. **I get INMI when I’m doing engaging mental activities such as reading or writing** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

55. **I get INMI when I’m doing routine activities such as housework, cleaning, or brushing my teeth** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

56. **Words that I hear or read trigger my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

57. **My INMI don't necessarily match my mood** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

58. **My INMI are not as vivid as hearing real music** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

59. **I don't like the music I have as INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

60. **I like my INMI** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

61. **When I get an INMI I try to manipulate it in my head** *
(e.g., make it play to the end, fill in musical details)
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

62. **When I get an INMI I mention it to other people around me** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

63. **My INMI contains music that I have never heard before** *
Mark only one oval.

	1	2	3	4	5	
Never	⬭	⬭	⬭	⬭	⬭	Always

64. **The INMI I get is from styles of music to which I would not normally choose to listen** *
Mark only one oval.

	1	2	3	4	5	
Never						Always

65. **My reaction to an INMI is to listen to/ sing/ hum/play the imagined music** *
Mark only one oval.

	1	2	3	4	5	
Never						Always

66. **In my life, there have been times when I've had INMI more frequently and times when it was less frequent** *
Mark only one oval.

	1	2	3	4	5	
Never						Always

67. **I enjoy INMI as much as listening to actual music** *
Mark only one oval.

	1	2	3	4	5	
Never						Always

68. **I get INMI when I would like to listen to music** *
Mark only one oval.

	1	2	3	4	5	
Never						Always

69. **If you have any comments or would like to share something related to your INMI please do so below:**

Personality questions

70. **I see myself as someone who:** *

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please pick a option for each statement to indicate the extent to which you agree or disagree with that statement.
Tick all that apply.

	1 Disagree strongly	2 Disagree moderately	3 Disagree a little	4 Neither agree nor disagree	5 Agree a little	6 Agree moderately	7 Agree strongly
Is talkative	☐	☐	☐	☐	☐	☐	☐
Tends to find fault with others	☐	☐	☐	☐	☐	☐	☐
Does a thorough job	☐	☐	☐	☐	☐	☐	☐
Is depressed, blue	☐	☐	☐	☐	☐	☐	☐
Is original, comes up with new ideas	☐	☐	☐	☐	☐	☐	☐
Is reserved	☐	☐	☐	☐	☐	☐	☐
Is helpful and unselfish with others	☐	☐	☐	☐	☐	☐	☐
Can be somewhat careless	☐	☐	☐	☐	☐	☐	☐
Is relaxed, handles stress well	☐	☐	☐	☐	☐	☐	☐
Is curious about many different things	☐	☐	☐	☐	☐	☐	☐
Is full of energy	☐	☐	☐	☐	☐	☐	☐
Starts quarrels with others	☐	☐	☐	☐	☐	☐	☐
Is a reliable worker	☐	☐	☐	☐	☐	☐	☐
Can be tense	☐	☐	☐	☐	☐	☐	☐
Is ingenious, a deep thinker	☐	☐	☐	☐	☐	☐	☐
Generates a lot of enthusiasm	☐	☐	☐	☐	☐	☐	☐
Has a forgiving nature	☐	☐	☐	☐	☐	☐	☐
Tends to be disorganised	☐	☐	☐	☐	☐	☐	☐
Worries a lot	☐	☐	☐	☐	☐	☐	☐
Has an active imagination	☐	☐	☐	☐	☐	☐	☐
Tends to be quiet	☐	☐	☐	☐	☐	☐	☐
Is generally trusting	☐	☐	☐	☐	☐	☐	☐
Tends to be lazy	☐	☐	☐	☐	☐	☐	☐
Is emotionally stable, not easily	☐	☐	☐	☐	☐	☐	☐

upset							
Is inventive	☐	☐	☐	☐	☐	☐	☐
Has an assertive personality	☐	☐	☐	☐	☐	☐	☐
Can be cold and aloof	☐	☐	☐	☐	☐	☐	☐
Perseveres until the task is finished	☐	☐	☐	☐	☐	☐	☐
Can be moody	☐	☐	☐	☐	☐	☐	☐
Values artistic, aesthetic experiences	☐	☐	☐	☐	☐	☐	☐
Is sometimes shy, inhibited	☐	☐	☐	☐	☐	☐	☐
Is considerate and kind to almost everyone	☐	☐	☐	☐	☐	☐	☐
Does things efficiently	☐	☐	☐	☐	☐	☐	☐
Remains calm in tense situations	☐	☐	☐	☐	☐	☐	☐
Prefers work that is routine	☐	☐	☐	☐	☐	☐	☐
Is outgoing, sociable	☐	☐	☐	☐	☐	☐	☐
Is sometimes rude to others	☐	☐	☐	☐	☐	☐	☐
Makes plans and follows through with them	☐	☐	☐	☐	☐	☐	☐
Gets nervous easily	☐	☐	☐	☐	☐	☐	☐
Likes to reflect, play with ideas	☐	☐	☐	☐	☐	☐	☐
Has few artistic interests	☐	☐	☐	☐	☐	☐	☐
Likes to cooperate with others	☐	☐	☐	☐	☐	☐	☐
Is easily distracted	☐	☐	☐	☐	☐	☐	☐
Is sophisticated in art, music, or literature	☐	☐	☐	☐	☐	☐	☐

Personal information

(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)

71. **I engaged in regular, daily practice of a musical instrument (including voice) for** *
Mark only one oval.

- 0 years
- 1 year
- 2-4 years
- 5-7 years
- 7-9 years
- 10 or more years

72. **If so, in what instrument?**

____

73. **At the peak my interest, I practiced daily:**
Mark only one oval.

- 0-0.5hrs
- 1-2 hrs
- 3-4 hrs
- 5hrs or more
- Other: ______________________________

74. **At the moment I practice daily:**
(last week's average)
Mark only one oval.

- 0 hrs- 0.5hr
- 0.5- 1hr
- 1-2hrs
- 3-4hrs
- 5hrs or more
- Other: ______________________________

75. **I would consider myself a musician** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

76. **I spend a lot of my time doing music related activities:** *
(listening, playing, going to concerts, searching for music, reading blogs)
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

77. **What is your age?** *
(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)
Mark only one oval.

- 18-25
- 26-40
- 41-65
- over 65
- prefer not to say
- Other:

78. **Please indicate your highest level of formal education attained (or which you are currently in the process of studying for).**
Mark only one oval.

- No formal education
- GCSE or equivalent
- A-level or equivalent
- Undergraduate or equivalent
- Postgraduate or equivalent

79. **Please write your nationality** *
If you prefer not to disclose this information,
please write: 'prefer not to'.

80. **What is your gender** *
(all responses will remain strictly confidential and will not be used for anything but the purposes of this study)
Mark only one oval.

- Female
- Male
- Prefer not to say
- Other:

Experience Sampling Method Details

81. **If you agree to participate in our ESM project please fill in the details below by clicking Yes. If not, please click no to complete this questionnaire** *
Mark only one oval.

- Yes, I would like to participate to the ESM project and I'm happy to fill in the details
- No, I don't want to participate to the ESM project, and I would like to submit this form. *Stop filling out this form.*

ESM questions

The questions below are designed to customise the ESM experiment to your schedule. If you have any questions, please contact Ioanna at ifilippidi1@sheffield.ac.uk

82. **Please pick the week you would like to participate:** *
The study runs from Thursday- Tuesday to ensure an equal distribution of weekend-weekdays in the two conditions. The normal music listening ESM will run Thursday-Friday-Saturday and the no music listening ESM will run Sunday-Monday-Tuesday. If this setup, or the dates provided below do not suit you, please choose Other, and email me to arrange something differently.
Mark only one oval.

- Thursday 2nd November - Tuesday 7th November
- Thursday 9th November - Tuesday 14th November
- Thursday 16th November - Tuesday 21st November
- Other: ______________________

83. **What is roughly your schedule** *
It is aimed to receive 6 alerts in a 12 hour period, so please state your preferred 12h window to receive the alerts. Also, if you have any times during the day in which you wish not to be disturbed please state in the 'other' box, or contact me at ifilippidi1@sheffield.ac.uk
Mark only one oval.

- 7am- 7pm
- 8am- 8pm
- 9am- 9pm
- 10am- 10pm
- 11am- 11pm
- Other: ______________________

84. **If you have any days/ times that you would prefer not to be disturbed, please let me know in the box below.**

85. **How do you usually listen to music I** *
Please pick the option you mostly use. If they are equal, please choose both, or please explain more in the OTHER box.
Tick all that apply.

- [ ] Personal Computer
- [ ] Mobile phone
- [ ] Mobile player (iPod, or MP3 player)
- [ ] Radio
- [ ] Live music
- [ ] Other:

86. **Do you have a LAST FM account** *
Mark only one oval.

- ( ) Yes
- ( ) No
- ( ) Not sure
- ( ) Other:

87. **If you have a LAST FM account, please share your username below**
You can also do that later, by emailing me

88. **How do you prefer to receive the alerts?**
Mark only one oval.

- ( ) Emails
- ( ) Emails + Text
- ( ) Both
- ( ) Other:

89. **In case you want to be alerted by text please provide your mobile number below.**

Thank you for your participation

You will receive an email with further instructions shortly.

- [ ] Send me a copy of my responses.

Appendix J

INMI in everyday life, an ESM study (Chapter 5), ESM form

ESM report

Please fill out the reports with as much detail as would you like to share, and as accurately as you can. If some of the questions are not applicable to your situation, please choose, or write N/A.

*Required

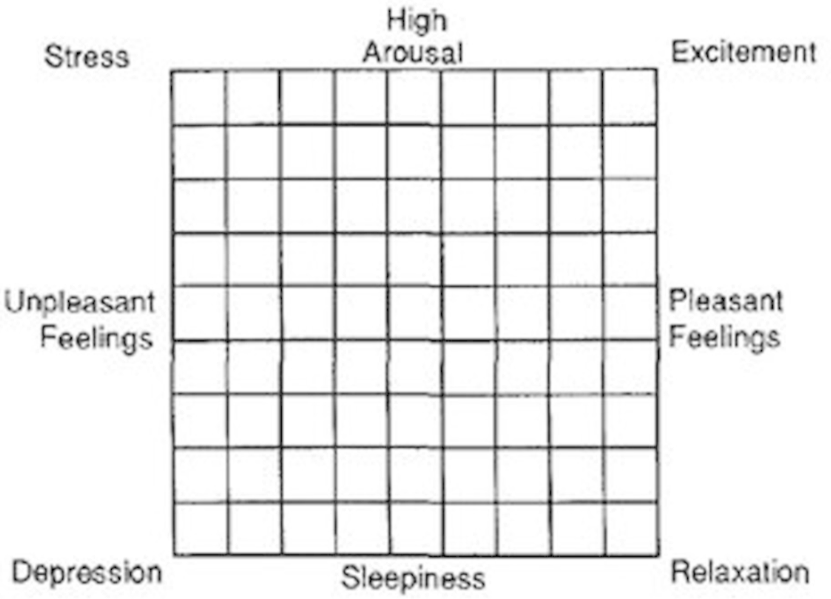
1. **Email address** *

2. **If this report is for a previous alert, please state so below.**
   Optional

Affect

By using the 'affect grid below, please answer the questions on how you feel. You will be answering in the linear questions for each dimension, but it may be helpful to assess where you are at the grid when you are answering.

Affect grid



3. **Energy** *
The vertical dimension of the map represents degree of arousal. Arousal has to do with how wide awake, ALERT , or activated a person feels—independent of whether the feeling is positive or negative. The top half is for feelings that are above average in arousal. The lower half for feelings below average. The bottom represents sleep, and the higher you go, the more awake a person feels. So, the next step up from the bottom would be half awake/ half asleep. If you imagine a state we might call frantic excitement (remembering that it could be either positive or negative), then this feeling would define the top of the grid.
Mark only one oval.

	1	2	3	4	5	6	7	8	9	
Very sleepy	◯	◯	◯	◯	◯	◯	◯	◯	◯	Very aroused

4. **Pleasure** *
The right half of the grid represents pleasant feelings. The farther to the right the more pleasant. The left half represents unpleasant feelings. The farther to the left, the more unpleasant.
Mark only one oval.

	1	2	3	4	5	6	7	8	9	
Very unpleasant feelings	◯	◯	◯	◯	◯	◯	◯	◯	◯	Very pleasant feelings

5. **Would you like to add anything regarding to how you are feeling right now?**
Optional

Musical imagery

Involuntary musical imagery (INMI) is the name for the experience of having music in your head unsolicited, without actual music playing. This can loop and repeat, or it can just play for a while (or even once) and then stop. You might have heard it recently, or can't remember when you heard it last. INMI can be pleasant, or annoying or even something in between. Please think of how the experience is like for you when answering the questions below.

Voluntary musical imagery is the name for the experience of having music in your head because you recalled it. Whether you are trying to remember a piece or lyrics, or actively imagining, voluntary musical imagery described the situation where you are in control of your imagery,

Please report all music in your head, whether it is voluntary or involuntary, repeated or played just once, if it is pleasant or annoying, or any other kind: please just make sure to clarify with your answers how this experience is for you now.

6. **Do you have music in your head right now or right before the alert?** *
Mark only one oval.

- Yes
- No *Skip to question 21.*
- Other:

Musical Imagery

Involuntary musical imagery (INMI) is the name for the experience of having music in your head unsolicited, without actual music playing. This can loop and repeat, or it can just play for a while (or even once) and then stop. You might have heard it recently, or can't remember when you heard it last. INMI can be pleasant, or annoying or even something in between. Please think of how the experience is like for you when answering the questions below.

Voluntary musical imagery is the name for the experience of having music in your head because you recalled it. Whether you are trying to remember a piece or lyrics, or actively imagining, voluntary musical imagery described the situation where you are in control of your imagery,

Please report all music in your head, whether it is voluntary or involuntary, repeated or played just once, if it is pleasant or annoying, or any other kind: please just make sure to clarify with your answers how this experience is for you now.

7. **Is the music in your head voluntary or involuntary?** *
Mark only one oval.

- Involuntary
- Voluntary
- Both
- Not sure
- Other: ____________

8. **Can you describe your musical imagery experience?**
For example: Is it looping? is it repeated? Is it pleasant? Or any other description you may have.

____
____
____
____
____

9. **Have you heard that music before** *
Tick all that apply.

- [ ] Yes
- [ ] No
- [ ] Not sure/may be
- [ ] N/A
- [ ] Other: ____________

10. **Have you heard that music recently?** *
Tick all that apply.

- [ ] Yes
- [ ] No
- [ ] Not sure/ may be
- [ ] N/A
- [ ] Other: ____________

11. **If you have heard that music recently, please give more information.**
Optional If you remember when, how, where, why or any other detail you may remember

12. **Please rate how familiar you are with that music?** *
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

13. **Please rate if this music is something that you would want to listen to now** *
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

14. **Please rate how pleasant is having that music in your head** *
This may be different to how pleasant the experience is for you now: you may like that music, but not liking it in your head now, and vice versa.
Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

15. **Please rate how much you like that music** *
This may be different to how pleasant the experience is for you now: you may like that music, but not liking it in your head now, and vice versa.
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

16. **Please rate how much attention you were paying to the music in your head** *
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

17. **Do you recognise the music in your head? (if so please specify title and composer / band/ lyrics)** *

18. **The music in your head:** *
Mark only one oval per row.

	Not at all	Not very much	Neutral	Somewhat	Very much so
changed or enhanced your mood					
entertained you					
accompanied your activities					
helped you socialise					
helped you to evoke emotions					
helped you to express your emotions and feelings					
helped you focus					
created the right atmosphere					
helped you to pass the time					
helped you to feel better					
helped you to escape the reality of everyday					

19. **How does the music in your head make you feel?** *
Mark only one oval per row.

	Not at all	Not very much	Neutral	Somewhat	Very much so
Alert					
Drowsy					
Happy					
Sad					
Lonely					
Connected					
Involved					
Detached					
Tense					
Relaxed					
Interest					
Bored					

20. **If you can recognise the genre of the music in your head, please pick from below**
More than one options may be appropriate
Tick all that apply.

- [ ] Alternative
- [ ] Blues
- [ ] Classical (+ instrumental)
- [ ] Country
- [ ] Electronica/dance
- [ ] Folk / Traditional
- [ ] Heavy metal
- [ ] Jazz
- [ ] Pop
- [ ] Rap / hip-hop
- [ ] Religious
- [ ] Rock
- [ ] Soul/ Funk
- [ ] I'd rather not say
- [ ] I don't agree with genres classification
- [ ] I am not sure
- [ ] Other: ____________

21. **Would you like to add anything regarding your musical imagery?**
Optional

____
____
____
____
____

Music listening

This section is about the music that you hear now, or just before the alert.

22. **Are you hearing music right now or right before the alert?** *
Mark only one oval.

- ( ) Yes
- ( ) No *Skip to question 34.*
- ( ) Other: ____________

Music listening

This section is about the music that you hear now, or just before the alert.

23. **Did you choose that music?** *
Tick all that apply.
- [ ] Yes
- [ ] No
- [ ] N/A
- [ ] Other: ____________________

24. **Have you heard that music before** *
Tick all that apply.
- [ ] Yes
- [ ] No
- [ ] I don't know
- [ ] N/A
- [ ] Other: ____________________

25. **If you can recognise the genre of the music, please pick from below**
More than one options may be appropriate
Tick all that apply.
- [ ] Alternative
- [ ] Blues
- [ ] Classical (+ instrumental)
- [ ] Country
- [ ] Electronica/dance
- [ ] Folk / Traditional
- [ ] Heavy metal
- [ ] Jazz
- [ ] Pop
- [ ] Rap / hip-hop
- [ ] Religious
- [ ] Rock
- [ ] Soul/ Funk
- [ ] I'd rather not say
- [ ] I don't agree with genres classification
- [ ] I am not sure
- [ ] Other: ____________________

26. **Please rate how familiar you are with that music** *
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

27. **Please rate how much you like that music** *
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

28. **Please rate how much attention you were paying to that music** *
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

29. **If above answer was positive, please elaborate: Did something in the music make you pay attention to it? Does it mean something to you?**
Optional

30. **The music that you listened to** *
Mark only one oval per row.

	Not at all	Not very much	Neutral	Somewhat	Very much so
changed or enhanced your mood					
entertained you					
accompanied your activities					
helped you socialise					
helped you to evoke emotions					
helped you to express your emotions and feelings					
helped you focus					
created the right atmosphere					
helped you to pass the time					
helped you to feel better					
helped you to escape the reality of everyday					

31. **How does the music that you listened to make you feel?** *
Mark only one oval per row.

	Not at all	Not very much	Neutral	Somewhat	Very much so
Alert					
Drowsy					
Happy					
Sad					
Lonely					
Connected					
Involved					
Detached					
Tense					
Relaxed					
Interest					
Bored					

32. **What type of music are you listening to? (genre, name, details)**
Optional If you don't remember the title, please provide any information you can to identify it: lyrics, description etc.

33. **Are you playing, or have you played music or an instrument since the last ESM alert?**
If so, please briefly state instrument, and describe repertoire and situation.

34. **Would you like to add anything regarding your music listening?**
Optional

Activities

35. **Where are you right now?** *
Please give a description of your whereabouts: i.e. home, work, gym, transportation etc.
Tick all that apply.

- [ ] Home
- [ ] Work
- [ ] University (if student)
- [ ] Transportation service
- [ ] Car
- [ ] Gym
- [ ] Cafe/restaurant/ bar/ pub
- [ ] Friend's house
- [ ] Shop
- [ ] Concert
- [ ] Other:

36. **What is your main activity?** *
Tick all that apply.

- [ ] Work/study
- [ ] House work
- [ ] Travel / commuting
- [ ] Walking
- [ ] Cooking
- [ ] Getting ready
- [ ] Self-care (shower, bath, saving etc.)
- [ ] Watching TV/movie
- [ ] Reading
- [ ] Listening to music
- [ ] Relaxing
- [ ] Sleeping (trying to/getting ready to sleep)
- [ ] Meditating
- [ ] Social Interaction
- [ ] Exercising
- [ ] Shopping
- [ ] Having a meal
- [ ] Celebrating / partying
- [ ] Playing games
- [ ] Concert/ theatre attendance
- [ ] Phone call
- [ ] Procrastinate
- [ ] Romancing
- [ ] Ruminating
- [ ] Socialising
- [ ] Praying/worshiping
- [ ] Other: ____________________

37. **Would you like to add anything regarding to what you are doing right now?**
Optional

Final page

If you have any further comments please use the space below, otherwise please PRESS SUBMIT.

38. **If you have any further comments on your day, your music listening, your INMI, or anything else, please use the section below to explain further.**
    Optional

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Appendix K

INMI in everyday life, an ESM study (Chapter 5), Post-study Survey

Post ESM questionnaire

*Required

1. **Email address** *

2. **How representative of your regular routine do you think this period was (6 days)?** *
   This question regards your overall routine (schedule, activities etc.) for the whole period of the 6 days. Please do not consider the musical abstinence when answering this question.
   Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

3. **If above question was negative, or if you have other comments regarding your everyday routine please elaborate.**

4. **How representative of your music listening do you think the first 3 days of the experiment were?** *
   This question regards your music listening for the FIRST three days, whether you were listening to music as you normally do, or if there were any differences.
   Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

5. **If above question was negative, or if you have other comments regarding your music listening please elaborate.**
This question regards your music listening for the FIRST three days, whether you were listening to music as you normally do, or if there were any differences.

6. **How representative of your INMI do you think the first 3 days of the experiment were?** *
This question regards the music in your head for the FIRST three days, whether you had music in your head as you would normally do, or if there were any differences.
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

7. **If above question was negative, or if you have other comments regarding the music in your head please elaborate.**
This question regards the music in your head for the FIRST three days, whether you had music in your head as you would normally do, or if there were any differences.

8. **How representative of your music listening do you think the last 3 days of the experiment were?** *
This question regards your music listening for the LAST three days, whether you were listening to music as you normally do, or if there were any differences.
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

9. **If above question was negative, or if you have other comments regarding your music listening please elaborate.**
This question regards your music listening for the LAST three days, whether you were listening to music as you normally do, or if there were any differences. If you have any comments regarding the musical diet, please elaborate here.

10. **How representative of your INMI do you think the last 3 days of the experiment were?** *
This question regards the music in your head for the LAST three days, whether you had music in your head as you would normally do, or if there were any differences.
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

11. **If above question was negative, or if you have other comments regarding the music in your head please elaborate.**
This question regards the music in your head for the LAST three days, whether you had music in your head as you would normally do, or if there were any differences.

12. **After seeing your Last FM spreadsheet, would you say that the list includes all your music listening of the past days?** *
Your Last FM recorded history spreadsheet was attached in the email. Please look at it and then answer this question.
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

13. **If above question was negative, or if you have other comments regarding your Last FM history please elaborate.**
If you had difficulties with it, or you listened to music elsewhere, or it was not recorded in this list, please elaborate.

14. **How engaged would you say you were with the study?** *
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

15. **How difficult it was for you to participate in the study?** *
In terms of practical- inconvenience.
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

16. **Do you have any comments on the practicalities of this study?** *
In terms of practical- inconvenience.

17. **How difficult it was for you to access the questionnaires?** *
In terms of practical- inconvenience.
Mark only one oval.

	1	2	3	4	5	
Not at all	⬭	⬭	⬭	⬭	⬭	Very much

18. **How difficult it was for you to participate in the musical abstinence?** *
To refrain from music
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

19. **Would you say that after the period of the musical abstinence, and after the study was over, you listened to more music than usual?** *
1 is not at all, 3 is approximately the same as usual, and 5 is much more than usual
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Very much

20. **Do you have any comments on the musical abstinence?** *
Did you notice any differences between the days of music listening to the ones without music listening? Did you notice any differences between the days of the musical abstinence (for example was Sunday different than Tuesday, did it get harder/easier?)

21. **If you have any other comments, remarks or opinions on this study you can elaborate here.**

22. **If you would like to receive your full profile, with your answers and your music listening, you can write your email below, with the note that you would like to receive a full profile. This may take a while (probably after February), but I will do my best to do this as soon as possible. Also, if you would like to receive any future publications that may derive from this study, also write your email, with a note regarding future publications.**

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Appendix L

INMI in everyday life, an ESM study (Chapter 5), Table L.1, Detailed genre responses.

Subject	MI genre		MI reports	ML genre (Survey)		ML reports	Pre-screen Genre
1	Pop	1	1	Alternative	2	13	Do not agree with genre classification
				Blues	1		
				Folk/Traditional	1		
				Pop	9		
2	Classical	4	10	Classical	1	8	Classical Electronica/dance Jazz Pop Rock Soul/ Funk
	Pop	3		Heavy Metal	1		
	Religious	1		Jazz	1		
	Rock	1		Pop	3		
	Not sure	1		Pop/Rock	1		
				Pure Music	1		
3	Classical	1	5	Alternative	1	3	Classical Country Folk /Traditional Rock
	Folk	1					
	Folk/rock	1		Pop/rock	1		
	Pop/rock	1					
	Rock	1		Rock	1		
4	Alternative	1	5	Alternative/Pop	2	4	Alternative Blues Electronica/dance Pop Soul/ Funk
	Alternative/ Electronica	1		Alternative/ Pop/ Soul, Funk	1		
	Pop	3		Pop	1		
5	Alternative	1	16	Electronica /Dance, Rap/ Hip hop	1	10	Jazz
	Alternative/ Rock	1		Jazz	1		
	Classical	2		Jazz, Soul/Funk	1		
	Jazz	2		Rap/ hip hop	2		
	Musical Theatre	1		Rock	1		

	Rap/ hip hop	1		Not sure	4		
	Ska	1					
	Soul/Funk	3					
	Not sure	4					
6	Pop	3	10	Classical	1	6	Alternative Electronica/dance Pop Rap / hip-hop Orchestra
				Pop	3		
	Not sure	7		Underground	1		
				Not sure	1		
7	Alternative, Classical	1	12	Alternative	1	6	Alternative Classical Electronica/dance Rock Soundtracks
	Alternative, Electronica/ Dance	1		Alternative, Electronica/Dance	1		
	Alternative, Indie	1		Alternative, Rock	2		
	Alternative Rock	1		Electronica/ Dance	1		
	Classical	1		Electronica/ Dance, Pop	1		
	Electronica/ Dance	2					
	Electronica/ Dance, Soundtrack	1					
	Harmony	1					
	Pop	1					
	Rap/ hip hop	1					
	Rock	1					
8	Alternative, Folk / Traditional	1	5	Electronica/dance, Chill step	1	7	Alternative Indie-rock
	Alternative, Pop	1		Folk / Traditional, Religious,	1		
	Pop	1		Background music	1		
	Pop, Rock	1		Not sure, Chilled dance	1		
	Rap / hip-hop	1		Pop	2		
				Rock	1		
9	Alternative, Classical	1	20	Alternative, Pop, Rock	3	7	Alternative Classical Pop Rock
	Alternative, Electronica/dance	1		Alternative, Rock	1		
	Alternative, Pop	1		Classical (+ instrumental)	1		
	Alternative, Pop, Rock	3		I am not sure	1		
	Alternative, Rock	3		Pop	1		
	Classical (+ instrumental)	1					
	Electronica/dance, Pop	1					

	I am not sure	3					
	Pop	6					
11	Alternative	1	5	Alternative	1	11	Alternative Electronica/dance Pop Rap / hip-hop Rock
	Pop	2		Alternative, Rock	1		
	Rap / hip-hop	1		Electronica/dance	1		
	Reggaeton	1		I am not sure	2		
				Jazz	1		
				Pop	4		
				Soul/ Funk	1		
12	Folk / traditional	1	4	Classical (+ instrumental)	2	11	Classical Pop Reggaeton
				Classical (+ instrumental), Pop	2		
	Pop	2		Classical (+ instrumental), Religious	1		
				Pop	2		
	Rock	1		Pop, Reggaeton	1		
				Pop, Religious	1		
				Reggaeton	1		
				Rock	1		
13	Electronica/dance	1	6	Alternative, Rap / hip-hop, Rock	1	8	Rap / hip-hop
	Electronica/dance, Rap / hip-hop	1		Alternative, Rap / hip-hop, Soul/Funk	1		
	Indie	1		Indie	1		
	Pop, Rap / hip-hop	1		Pop	1		
	Rap / hip-hop, Religious	1		Pop, R&B	1		
	Soul/ Funk	1		Rap / hip-hop	2		
				Soul/ Funk	1		
14	Electronica/dance	1	8	Folk/ Traditional	1	1	Classical Pop
	Electronica/dance, Pop	1					
	Folk / Traditional	1					
	like the background music you	1					
	Pop	4					
15	Classical (+ instrumental)	2	6	Classical (+ instrumental)	2	6	Alternative Blues Classical
	Pop, Rock	2		Mixed playlist	1		
	Soul/ Funk	2		Pop, Soul/ Funk	1		

				Rap / hip-hop	1		Electronica/dance Folk / Traditional Jazz Pop Rap / hip-hop Rock Soul/ Funk
				Rap / hip-hop, Soul/ Funk	1		
16	Alternative	1	24	Alternative, Rock	1		Alternative
	Alternative, Electronica/dance	2					
	Classical (+ instrumental)	3		Classical (+ instrumental)	1		
	Electronica/dance	1					
	Electronica/dance, Pop	5		Rap/ hip hop	1		
	Heavy metal	1					
	Pop	6		Soul/ Funk	2		
	Pop, Rock	1					
	Rap / hip-hop	2					
	Rock	2					
18	Deathcore	2		Alternative metal	2		Alternative; Heavy metal; Jazz; hardcore, hardcore punk, punk, techno, progressive rock
	Electronica/dance	2		Deathcore	1		
	Hardcore	1		Electronica/dance	1		
	Hardcore punk	1		Electronica/dance, ambient	2		
	Progressive Rock	1		Emo/Screamo/Hardcore punk	1		
	Punk rock	1		Hardcore punk	1		
	Rap / hip-hop	1		Metalcore	1		
				Nu-metal, Alternative metal	2		
				Post-rock	2		
				Progressive Rock, Psychedelic	2		
				Rock	2		
19	I am not sure	5	19	Jazz	2	4	Jazz; Pop Soul/ Funk Musicals
	Jazz	5		Jazz, Pop, Soul/ Funk	1		
	Musical theatre	4		Pop, Musical theatre	1		
	Pop	4					
	Pop, Musical Theatre	1					
20	Alternative, Pop, Rock	1	9	Heavy metal, Rock	1	1	Heavy metal Rock
	Alternative, Rock	1					

	Electronica/dance, Pop, Video game	1					
	Heavy metal	5					
	Heavy metal, Rock	1					
21	Alternative, Pop, Rock	2	28	Alternative, Rock	1	5	Pop Rock
	Alternative, Rock	3					
	Electronica/dance, Pop	1					
	I am not sure	1		Folk/ Traditional, Rock	1		
	Instrumental, video game	1					
	Merengue / Latin American rhythm	1					
	Pop	4		Pop	1		
	Pop, Rock	3					
	Rock	7					
	Rock, Glam rock	3		Pop, Rock	2		
	Rock, Soul/ Funk	1					
	Soul/ Funk	1					

Appendix M

INMI in everyday life, an ESM study (Chapter 5), Detailed genre responses

In an attempt to further investigate the discrepancy between the music listening and MI ratings from the background correlations with extraversion, the next Table M.1, illustrates the BFI scores for each participant, along with the number of reports from ESF regarding music listening, musical imagery or anything else (that is no music, named ‘other’ in table) during exercise. The table also includes the self-ratings from the background survey on whether the participants reported listening to music while exercising and whether they experience INMI while exercising. This table serves as an example for one particular function of music, for which there were enough ratings from both the background survey and the ESF. Moreover, the self-assessed ratings from the background survey were significantly correlated with the BFI scores of the participants, so it was deemed worthy of interest to examine firstly how and if the self-reports are reflected at the ESF and how inclusive those ratings were. On several occasions where the background ratings were high for both music listening and MI, no such behaviour was recorded during the ESM week (subjects 1, 2, 6, 9). Moreover, seven of the participants who picked the high ratings of listening to music while exercising (subjects 1, 2, 6, 7, 8, 12, 15, 21) also reported exercising without music (labelled as ‘other’ on table). Lastly, a participant who did not answer positively on the question of listening to music while exercising (subject 15), did report listening to music while exercising, but also MI while exercising.

Table M.1, Example of exercise ESF, background survey and BFI individual scores

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness	Condition	Exercise ESF	Exercise background	
1	4.75	4.22	3.78	4.38	4.2	ml		5	
						mi			4
						other	1		
2	2.38	4.67	3.44	5	3.6	ml		5	
						mi			4
						other	2		
3	2.75	3.89	4.78	5.25	5.5	ml		5	
						mi			2
4	2.63	5.44	4.56	3.88	5	ml		2	
						mi			4
5	4.25	6.11	4.67	2.63	5.8	ml		3	
						mi			3
6	6.13	6	4.78	3.63	5	ml		5	
						mi			3
						other	1		
7	6	6	5.89	3	5.9	ml	1	5	
						mi	1		2
						other	3		
8	4.75	5.67	5.33	5.13	5.8	ml	1	5	
						mi	1		2
						other	2		
9	4.38	5.11	3.44	5.75	4.8	ml		5	
						mi			4
11	4.75	5.56	5.33	2.63	3.8	ml	1	5	
						mi			1
12	5.5	5.33	6	4.13	5.2	ml	1	5	
						mi			2
						other	1		
13	5.25	5.78	5.22	2.75	5.3	ml		5	
						mi			1
14	5.38	5	5	3.13	6.7	ml		5	
						mi			2
15	3.5	5.33	4.22	3.13	5.9	ml	1	3	
						mi	1		2
						other	1		
16	2.88	5.33	4	4.63	5.6	ml		2	
						mi			3
18	3.13	4.22	2.67	5.75	5.9	ml		4	
						mi			3
19	2.88	5.89	4.89	3.75	5	ml		2	
						mi			5
20	2.75	4.44	4.22	4.75	5.4	ml		4	
						mi			1
21	2	5.78	5.67	4.5	5.5	ml		4	
						mi	1		5
						other	1		

Table M.1 highlights the incongruities between the self-reports of participants who said that they listen to music while exercising, and the ESM reports of the same participants showing many instances where those participants were exercising without music. This finding raises some questions: On the one hand, this may be a matter of chance and a non-sufficient observation period or different types of exercising (for example, the subject could be listening to music while running, and doing yoga without any music, and their schedule was running on Sundays when the 'diet' was implemented). However, as there were reports of exercising, with music listening, in the some of the same participants who picked the highest ratings (always listening to music while exercising) this may be an illustration of bias on the self-assessed reports, posing a further possible issue on the credibility of such reports. For the conditioning process to happen, the associated action should take place consistently: in cases where it sometimes does not, the association would not take place. This is perhaps a partial answer to individual differences: when an action is sometimes associated with music and sometimes it is not, it becomes difficult to know if the association took place, and whether the mind associated this action with music or with something else that it was combined with. Accordingly, in cases like subject 15 (Table M.1) where they self-reported not listening to music nor having MI while exercising, and they reported both on their ESF, the issue of the credibility of self-reports also emerges: even if a person does not realise their actions, these actions may still create the aforementioned associations, and result in musical imagery.

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