Perception of, subjective feeling and physiological responses to emotion in music according to affective state

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Abstract

The ability of music to induce emotion is a disputed phenomenon. The aim of this study is to examine the perception of, subjective feeling, and physiological arousal to the emotion expressed in music. Ninety participants listened to an audio clip of unfamiliar instrumental music while heart rate and skin conductance were recorded. Participants were randomly assigned to three music conditions: happy, sad and neutral. The PANAS questionnaire was completed prior to exposure to the music stimulus to establish general affective state. Following the excerpt, participants completed the Geneva Emotional Music Scale, a self-report measure of the subjective feeling of musically induced emotions. A report of the perception of the emotionality of the music was included in the demographic questionnaire. A significant difference was indicated between the perception of the emotion expressed in the music, the subjective feeling and physiological responses; demonstrating recognition of emotion is greater than is musically induced.

Introduction

Music and Emotion:

The ability of music to express emotion is a phenomenon that has interested psychologists and philosophers dating back to Plato's "The Republic" and Homer's Odyssey (Zentner, 2010). Music is at its essence, sounds, yet it is capable of evoking reactions in the listener (Juslin & Västfjäll, 2008). The extent and nature of these reactions remains of much debate across the many disciplines researching these two constructs. The controversy lies in how and in what way music can evoke an emotional reaction in the listener? This raises the question of whether music can induce a subjectively felt emotion or it is the perception of the emotion in the music that is responsible for the reaction (Konečni, 2003)? What is the nature of this reaction? Does physiological arousal to the structure or tempo of the music instigate the potential emotional response (Gomez and Danuser, 2007); or is there a connection between the perception of the emotion and the felt emotion (Zentner, 2010)? Similarly, are we consciously aware of how our body reacts to the emotionality of music and does it correspond with our subjectively felt response (Krumhansl, 1997; Bartlett, 1996)?

Theories of Emotion and Music:

Emotion is defined in the Oxford Handbook of Music and Emotion as "relatively intense affective responses that usually involve a number of sub-components including subjective feeling, physiological arousal, expression, action tendency and regulation; which are more or less synchronised; emotions focus on specific objects and last minutes to a few hours", (Juslin & Sloboda, 2010, p. 10). This definition alone introduces difficulties regarding the use of the word emotion to describe the sentiment expressed by music. As music is merely varying combinations of sounds, theorists argue regarding the nature of the ability of "music" to express emotion. Further, there is debate as to whether there is a qualitative difference between musically expressed emotions and other emotions (Hunter, Schellenberg and Schimmack, 2010). Zentner, Grandjean and Scherer (2008) highlighted that research investigating music and emotion have employed emotion theories such as basic emotion theory (Darwin, 1998; Eckman,1971) and Russell's (1980) circumplex model of affect to explain musically expressed emotion. Basic emotion theory is a categorical approach postulating that emotion is limited to basic innate universal emotions such as fear or anger, which are not necessarily expressed or induced through music. Evolutionary requirements may have resulted in the basic emotion categories relating to goal orientated events (Juslin and Västfjäll, 2008).

Russell's (1980) circumplex model is a two-dimensional model of affect, mapping arousal levels onto one dimension and valence onto the other. Therefore, an individual could report high arousal levels with negative valence or vice versa. Many researchers investigating music and emotion have employed this model to record the participants' responses (e.g. Vieillard et al., 2008; Khalfa, Roy, Rainville, Dalla Bella, & Peretz, 2008; Schellenberg, Nakata, Hunter & Tamoto, 2007). However, due to the bipolarity of the valence dimension, there is no allowance for mixed emotional responses i.e. both positive and negative affective responses. Zentner (2010) and Juslin and Västfjäll (2008) argue that the majority of empirical research studies examining the effect of music on emotion have been restricted by utilising affect terms devised from Russell's circumplex model. Hunter, Schellenberg and Schimmack (2010) reported that excerpts that contained mixed happy and sad cues, in fact received simultaneous happy and sad responses, which is not accounted for in the circumplex model.

Scherer, Zentner and Schacht's (2001) findings suggested that emotions outside of the standard basic emotions may be evoked through music. A meta-analysis by Zentner and Eerola (2010) found that the basic emotion theory and circumplex models accounted for 80% of studies conducted into musically evoked emotions, demonstrating the need to examine the results of a multidimensional domain-specific approach.

Zentner, Grandjean and Scherer (2008) have highlighted the importance of distinguishing between utilitarian (basic) emotions and aesthetic emotions in the examination of musically induced emotions. They argue that reactive necessity is the basis for utilitarian emotions whereas aesthetic emotions lack a trigger that is absolutely defined; as such they can be experienced purely to savour their qualities, which they proffer is the basis of the emotional experience of music. They devised the Geneva Emotion Music Scale (GEMS), a self-report questionnaire that examines what the participant subjectively felt elicited by the music in terms of these blended emotions. Due to the domain-specific nature of this measurement of subjective responses to music, and the focus on the aesthetic or blended nature of emotions it is argued that it is more sensitive to the emotions in music that are felt as opposed to borrowing terminology that are reflective of cognitive or propositional states (Zentner, 2010). For example, transcendence, used in the GEMS is not a lexicon typically associated with emotions; however, their research suggests that it is strongly correlated with characteristic physiological responses to musical emotions such as chills (Zentner, Grandjean & Scherer, 2008).

Schubert (2010) building on Gabrielsson's (2001) findings highlighted the need to determine the locus of the emotion in music listening. He postulated that aesthetic judgement on the part of the listener indicates an internal emotional locus, i.e. subjective feeling of emotion in response to music. Similarly, the perception of the emotion being expressed in the music is considered an external emotional locus, as Konečni (2008) maintained that music cannot induce emotions; rather, listeners purely recognise the emotion that is musically expressed. Gabrielsson (2001) remonstrated that not stating which locus is under investigation or failure to examine both loci to be a limitation of most research in this field. This has served as a rationale for this present study, to clearly demarcate the distinction between the perceived and felt emotion through the use of separate questionnaires to identify the locus involved.

Music expression and music induction:

Cognitivist approach:

Cognitivist theory highlights the significant role played by cognitive appraisal in emotional responses to music. According to this view, emotion is therefore perceived but not experienced by the listener in the music's structure, which may be due to the non-sentient nature of music (Konečni, 2003). Konečni's (2003) Prototypical Emotion-Episode Model (PEEM) postulates that an event is initiated by sensory stimuli which once perceived and attended to are brought into conscious awareness through attributional processes. Cognitive attribution alters arousal levels leading to emotional labelling resulting in behavioural changes. His principal criticism of music being classified as an event in the PEEM model is the uncertainty of the emotion-labelling stage occurring. As such, emotional perception may take place without emotional involvement from the listener as it is principally a cognitive sensory process. Cognitivist theorists maintain that the appraisal of an event is capable of influencing the perceiver's goals. Therefore, they argue that music lacks this goal-affecting ability and is thus unable to induce emotion (Kivy, 1990, Konečni, 2008). Konečni (2008) and Juslin and Sloboda (2010) suggested that it is the cognitive associations and memories of events that mediate the induction of emotions by music but that they are of low-intensity. Schubert (2007) found that expressed emotions were more frequently reported by listeners than were subjectively felt emotions; and that they were reported as stronger than these internal locus emotions. A focus of this current investigation is to remove the cognitive involvement by examining the arousal levels through physiological markers of skin conductance and heart rate to instrumental unfamiliar music devoid of mental associations. However, participant selected music pieces have been reported as more successfully inducing the intended emotion than experimenter selected familiar and unfamiliar passages of both lyrical and instrumental nature. This suggests the influence of episodic memories and subjective associations in the induction of emotion through music (Juslin & Laukka, 2008).

Emotivist approach:

In contrast, the emotivist school proffer a certain level of connection between musically expressed emotions and those subjectively felt by the listener (Levinson, 1996; Robinson, 1994). Zentner's (2010) Induction Rule Model is a multiplicative model of four primary categories classifying the factors that induce emotion in the listener from music. They are classified as structural features, listener features, performance features and contextual features. These features are facilitated by emotion inducing mechanisms such as memory, entrainment, empathy and conditioning (Juslin & Sloboda, 2010). It is not anticipated that any one factor would evoke emotional effects in the listener independent of the other factors; rather it is a multiplicative functional effect (Zentner, 2010). An aim of this study is to investigate this hypothesis by attempting to control for performance and contextual features, placing the focus on structural features of the music to evoke a response in the listener.

In line with emotivist theory, Zentner, Grandjean and Scherer (2008) identified 9 emotional dimensions through a process of confirmatory factor analysis of musical affect ratings. They found consistency in the emotional terms employed between their findings and those of Juslin and Laukka (2004) and Laukka (2007) both cross-sectionally, cross culturally as well as in different contexts and genres of music. Musically induced sadness may differ from the basic emotion sadness as descriptions such as unhappy, depressed or gloomy were rarely reported in conjunction with sadness in response to music (Zentner, Granjean & Scherer, 2008; Laukka, 2007). Interestingly, nostalgia is widely reported response to the emotionality of music which may be indicative of the functionality of music. However, it may be more supportive of the influence of memories and imagery in music's ability to induce emotion (Konečni, 2008; Juslin & Västfjäll, 2008).

Based on the Oxford Handbook's definition of emotion, supporting evidence is required demonstrating that each of the sub-components of emotion (subjective feeling, physiological arousal, expression, action tendency and regulation) are affected by music to induce emotions. Misattribution of the perception of the emotion expressed in the music may lead to an inflated response for the listener's own emotional feeling towards the passage. Konečni (2008) and Zentner (2010) in particular, have highlighted the importance of clarity of the instructions and the experimental design. For example, studies by Juslin (2000), Sloboda and Lehmann (2001) and Krumhansl (1997) were designed to examine the expression of emotion by music, however ambiguity in directions lead to many participants interpreting the task incorrectly and responding to the questions as if the music induced subjective emotions or both perception and induction of emotions were to be rated. In Krumhansl' s (1997) experiment participants were instructed with the following statement, " Music is thought to have many effects on people, including influencing their emotions [...] the slider should be at the far right if you feel that emotion as strongly as you have in response to music in the past" (Konečni, 2008, p. 121). It is noted by Konečni (2008) that the inclusion of the opening statement may have primed participants to respond in a more inflated manner than they actually felt. Interestingly, when the experiment was retested with the opening phrase replaced by "Researchers disagree on whether or not music has an effect on emotion", there was a significant reduction in the ratings Konečni, 2008, p.121). He similarly reported that the substitution of "the music" for "you felt" also indicated huge implications for the results. It was also suggested that participants may experience evaluation apprehension and refrain from choosing zero on the Likert scale when rating their subjective feeling to the music. It may also be the case that the response given by the listener is inflated due to misattribution of the perceived emotion of the music as their subjective response as outlined above. The use of separate questionnaires in this study will attempt to control for the limitations of previous research in this respect.

Prior to Zentner, Grandjean and Scherer's (2008) investigations regarding the character and classification of the emotionality of music, there were a number of conceptual issues affecting the research in this area. Many studies failed to differentiate between perceived and felt emotions in their design and methodology, thus findings were unclear as to which was being referred to. Similarly, the affect terms used were borrowed from other emotional studies and were not specific to the music genre. Methodological rigour was not upheld in many papers deemed seminal such as Krumhansl (1997). This study will attempt to address these shortcomings through the separation between the focus of perceived and felt emotion in separate questionnaires and the clear instruction of this distinction. A focus of the current study is to control for performance features, to focus on listener features and determine the subjective experiential nature of music perception and response.

Physiological responses to Music:

The identification of physiological differentiation of emotional responses to musical stimuli may provide supporting evidence for the emotivist argument, of music's ability to induce an emotional response in the listener. Physiological arousal is classified as one of the sub-categories of emotion; and is defined in the Oxford Handbook of Music and Emotion as "the physical activation of the autonomic nervous system" (Juslin & Sloboda, 2010, p. 10). Juslin and Västfjäll's (2008) meta-analysis of the literature supporting the physiological arousal effect of music found that the physiological arousal levels reported by for example, Krumhansl (1997), Bartlett (1996), and Nyklíček, Thayer, & Van Doornen, (1997) included changes in heart rate, respiration, electrodermal skin conductivity and hormonal secretion similar to the physiological responses reported for other emotional stimuli. Music is composed of sounds which are ordered by the structural features; therefore, sounds that are comprised of fast, noisy, loud, very low or very high frequency for example, have been demonstrated to arouse an augmented activation of the central nervous system (Krumhansl, 1997; Nyklíček, Thayer, & Van Doornen, 1997). Examples of structural features include musical features such as tempo, timbre; meter, harmonic progression etc. and they are considered to have universal and stable effects.

Khalfa, Peretez, Blondin and Manon (2002) found a positive correlation between cardiac interbeat intervals, systolic and diastolic blood pressure. They also reported a negative correlation between skin conductance level, finger temperature and sadness ratings. Fast tempo, loud dynamic and high rhythm characteristic of high- arousing music correlates with physiological markers of increased heart rate and reduction in skin temperature. According to Gomez and Danuser’s (2007) study the structural features of music that most significantly facilitated the distinction between positive and negative music excerpts were tempo and pitch and they correlated with physiological changes in heart rate, respiration and electrodermal activity. The brain stem reflex is reported by Joseph (2000) as the underlying neural mechanism controlling emotional arousal, heart rate, breathing and movement as well as auditory perception, providing a link between music and emotion. Berlyne (1971) theorised that musical stimuli that evokes a physiological arousal of optimum level is the most preferred. He postulated that the music may be disliked if the arousal level is too high or too low. There is an association between positive valence and high arousal and fast tempo typical of happy music (Dalla, Peretz, Rousseau & Gosselin, 2001). Similarly, Miu and Baltes (2012) reported that musically induced positive emotion in their participants’ was correlated with autonomic arousal demonstrated through the physiological markers of increased heart rate, decreased respiration rate and a reduction in the electrodermal activity compared to baseline measures. The aim of this investigation is to examine the arousal levels in response to unfamiliar instrumental music to determine the involvement of structural features in the induction and perception of emotion, as opposed to cognitive associations and memories with familiar extracts. The use of self-report questionnaires to describe the listener's perceived and felt emotion in response to music may be subject to demand characteristics. Physiological responses have also been selected for inclusion as an attempt to control for this potential confounding variable. However, there are conflicting reports of the distinguishability of the physiological changes due to differing musical emotions (Nyklíček, Thayer, & Van Doornen, 1997; Krumhansl, 1997; Lundqvist, Carlsson, Hilmersson, & Juslin, 2009). Also, there are conflicting reports of the ability to attribute physiological changes to the emotionality of the music over structural features such as the tempo as occurs in entrainment (Etzel, Johnsen, Dickerson, Tranel, & Adolphs, 2006; Gomez & Danuser, 2007).

Mood/ Affect and music perception

Hunter, Schellenberg and Schimmack (2010) reported that the emotions expressed in the music are frequently matched in the listener's subjective feeling self-report. They found that happy music receives higher preference ratings than sad music as well as a positive impact on mood. Vieillard et al. (2008) however did not find the same positive effect of happy music on their participants' moods. They hypothesized that listeners in a negative mood state may have a preference for sad sounding music and thus may have rated it more highly. Hunter, Schellenberg and Griffith (2011) also postulated that mood-congruent memory may augment perception of positive or negative attributes of the music. For example, a positive mood prior to listening to a happy music excerpt may cause a heightened response to the happy sounding music. Garrido and Schubert (2011) found that regardless of an individual's perception of the music as pleasurable or not there is a link with their arousal level. Another aim of this investigation is to examine the association of affect valence with subjective and perceived emotion in response to music as this is a hinging feature of the dimensional model which is lacking in the GEMS approach.

Garrido and Schubert (2011) investigated the hypothesis that negative emotions in music are enjoyable. Vuoskoski and Eerola (2012) also reported that many individuals enjoy listening to sad music, and that it does not automatically correlate with feelings of sadness. Hunter, Schellenberg and Griffith (2011) also postulated that the aesthetic nature of the medium of music does not equate to the negative affective valence that may be induced by other stimuli which evoke the basic emotion of sadness. They induced happy, sad and neutral moods on their participants and reported findings that indicate that those participants induced with a sad mood through pictures of injured animals, demonstrated a preference for the sad sounding excerpt. Manipulation of the musical stimuli to provide conflicting cues of happiness and sadness e.g. fast tempo coupled with minor mode, resulted in a significant influence of mood induction on the perception of emotionality of the music. It may imply that individuals attend to the cue that is mood-congruent; this will be investigated in relation to the association between PANAS scores and the affect valence of the assigned music condition.

Juslin and Västfjäll (2008) noted that due to the wide variety of music genres used coupled with methodological and contextual discrepancies as outlined above, a wide differentiation in the investigative process has occurred. Findings are inconclusive as to the ability of music to induce felt emotion or it is solely perceived; and the similarities and differences between these two emotional responses (Hunter, Schellenberg & Schimmack, 2010).

Aim:

The objective of this experiment is to investigate the perceived emotion, subjective felt and physiological responses to music passages expressing 3 different emotions musically; (sad, happy and neutral). Instrumental unfamiliar music has been selected in order to avoid the associations that may occur from listening to familiar or music with lyrics; and thus permits the evaluation the aesthetic experience.

Furthermore, the general affect valence of participants may influence their susceptibility to experience musically induced emotions. For this reason, another aim of this experiment is to include a measure to establish the valence of the participants' affect, and to determine if there is a relationship between this valence and their physiological and subjective feeling of musically induced emotions across the sad, happy or neutral music conditions.

Hypotheses:

1. a) There will be a significant difference between the music conditions (sad, happy, neutral) in the perception of emotion in the music

b) Subjective feeling responses of the listener will be significantly different between the music conditions

c) There will be a significant difference in the physiological responses (change in heart rate and skin conductance) between the music conditions

2. There will be a significant correlation between the physiological responses (changes in heart rate and skin conductance) and the subjectively felt responses (as measured by Vitality, Sublimity, Unease GEMS scores)

3. a) Positive and Negative Affect valence (PANAS scores), perceived emotion, the Neutral music condition will be significantly correlated with sublimity subjective feeling

b) Negative PANAS scores, the sad music condition and perceived emotion will be significantly associated with unease scores

c) Positive PANAS scores, the happy music condition and perceived emotion scores will have a significantly relationship with vitality scores

The goal of this research is to determine the correlation between the valence of a music passage and the change in the physiological and subjective feeling responses of the listener. The benefits of this knowledge may be employed in the realm of music therapy whereby music may be utilised to modify behaviour and alleviate negative emotional states and potentially induce positive feelings in the listener (Thaut, 2010).

Method

Participants:

An opportunity sample of 90 adults (42 male, 48 female) was recruited for the experiment. Participants were sourced through advertisements on notice boards in the DBS buildings, social media sites such as Facebook, Linked-in, Researchgate, and; giving oral presentation of the research to part-time and higher diploma psychology classes. Recruitment was also conducted through mailshots to DBS Psychological Society members, PSI student groups and through the Dublin branch of the Association of Choirs website. Thirty participants were randomly assigned to each of the three music conditions, (sad, happy, and neutral). The sole inclusion criteria for the experiment were: participants were over 18 years of age and had a strong command of the English language. Participation in the experiment was on a voluntary basis and no reimbursement or reward was offered as per the College Guidelines. Participants ranged in age from 18-24 years to 65+ age bracket ($M_{age\ bracket}$= 2.66, $SD_{age\ bracket}$= 1.90), with 41% in the 18-24 years age bracket. Eighty three per cent of the participants were of Irish nationality. There were one professional musician, and seven semi-professionals, however the majority of participants self-reported as amateur/non-musicians (90%).

Design

A quantitative between-participants experimental design was implemented to examine the effect of differing emotionality of music on: the perception of the emotion expressed in the music, the subjective feeling, and physiological responses of the listener. Random allocation of 30 participants to each of the three music conditions (sad, happy, and neutral) was performed to reduce the effects of individual differences. The independent variables were the three levels of the emotionality of the music. The dependent variables were the recognition of the emotion in the music; the subjective feeling responses; the heart rate changes and the electrodermal changes between the baseline and music listening periods. A correlational design was also utilised to test for the association between affect valence and recognition of the emotion expressed in the music and the listener's subjective feeling response. The positive and negative affect scores, the recognition of the emotion, and physiological responses were the predictor variables and the recognition of the emotion and the criterion variables were subjective feeling responses.

Materials

Questionnaires

Pen and paper self-report measures were administered in this study, including the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988); the Geneva Emotional Music Scale (GEMS-9; Zentner, Grandjean & Scherer, 2008); and a questionnaire devised by the experimenter consisting of demographics questions as well as a report of the perception of the emotion expressed in the music.

Positive and Negative Affect Schedule (PANAS)

The PANAS is a 20 item self-report questionnaire that assesses positive and negative affective valence (see appendix B). It consists of ten positively valenced descriptive terms such as attentive or enthusiastic interspersed with ten negatively valenced terms for example distressed or ashamed. Participants are required to provide a rating for each item to indicate to what extent they have felt in that way during the time period specified by the experimenter. Items are rated on a 5 point Likert scale (ranging from 1 = *very slightly/not at all* to 5= *extremely*). The scale is used to measure dispositional or general affective state. Participants in this experiment were instructed to consider their responses in terms of how they felt over the past week. Positive Affect (PA) scores are calculated by summing the scores for items 1, 3, 5, 9, 10, 12, 14, 16, 17 and 19. The total score therefore can range from 10-50, with higher positive affect reflecting higher scores. Weekly mean scores are reported as 33.3 (*SD*= 7.2). Negative affect scores are calculated by totalling the scores for items 2, 4, 6, 7, 8, 11, 13, 15, 18 and 20. The total Negative Affect (NA) score ranges between 10 and 50; with lower scores indicating lower negative affect. The weekly mean score is 17.4 (*SD*= 6.2). Watson, Clark and Tellegen (1988) reported Cronbach's alpha coefficients for the PA as ranging from .86 to .90, and .84 to .87 for the NA scale. Eight week Test-retest correlations were between .47 to .68 for PA, and NA ranged from .39 to .71. They also reported evidence for the validity of the PANAS, as depression, general distress and state anxiety are positively correlated with the NA scale. Crawford and Henry (2004) repeated these finding in a UK population concluding that the PANAS had high validity and reliability in measuring the constructs intended. Cronbach's alpha in this current study was .87 for PA scale and .88 for NA scale respectively.

Geneva Emotional Music Scale (GEMS-9)

The GEMS is a unipolar nine item scale that measures subjectively felt emotion when listening to music. It contains domain-specific music emotion factors such as wonder and joyful activation (see appendix D). These factors have a number of characteristic feeling terms outlined beneath them for example wonder is described as filled with wonder, amazed, dazzled, moved. Participated rated each factor on the accompanying 5 point Likert scale, selecting the value that best corresponds to how the music made them feel (ranging from 1= *not at all* up to 5= *very much*). Three super factor variables (vitality, sublimity, unease) were calculated from combining the results of the factor ratings that blended together as per confirmatory factor analysis (Zentner, Grandjean & Scherer, 2008). The Vitality superfactor variable combines the joyful activation and power factor results. Sublimity was calculated by adding the results for the wonder, transcendence, nostalgia, peacefulness and tenderness factors. Sadness and tension factors were combined to create the unease superfactor variable.

The GEMS was selected for use as it is intended to investigate combinations of blended emotions, rather than the basic emotions which are the focus of most other emotion scales. Zentner (2011) argued that musical emotions are composite or blended as they lack an absolute trigger. It is more likely that an emotional reaction will occur as a result of the music's combinations and patterns of sounds. The GEMS differs from basic emotion scales in that most of the scale items are positive. It also includes central terms that are somewhat unique such as transcendence and nostalgia. Zentner, Grandjean and Scherer (2008) reported comparative validity in support of the GEMS domain-specific model over basic, and dimensional models in terms of choice of emotion terms (r= .90); higher inter-participant agreement with intra-class correlation coefficient (ICC= .89); and greater discrimination of the musical passages. Cronbach's alpha in this study was .68 for vitality, .62 for sublimity and .50 for unease. Ideally values should be greater than .70, however scales with less than 10 items often do not, therefore the scales were left unedited for use (Kline, 2005).

Experimenter devised demographics questionnaire

The experimenter devised questionnaire (see appendix E) included demographics questions regarding the gender, age bracket (*18-24, 25-29, 30-34, 35-39, 40-49, 50-64, 65*+) and musical experience of the participant (1= *professional musician*, 2= *semi-professional*, 3= *amateur/non-musician*). Section B included a 7 point Likert scale to determine the valence of the emotion perceived as expressed by the music (ranging from 1 = *very sad* to 7 = *very happy*). This section was included to clearly distinguish between perceived and subjectively felt emotions from music to avoid misinterpretation of the question by the participants as occurred in other studies (e.g. Krumhansl, 1998).

Stimuli

Due to time constraints the music passages utilised in the study were selected as they had been previously used and validated by Vuoskoski & Eerola (2012). The excerpts were selected based on their ability to clearly convey the intended emotion throughout the course of the passage and their unfamiliarly to the listener. The duration of each excerpt was at least eight minutes and 30 seconds in length to facilitate the recording of accurate physiological results. The sad music passage was entitled Discovery of the Camp, track 17 from the Band of Brothers soundtrack by Kamen (2001) (see appendix C). The track was started at 2.25 minutes in and played for eight minutes and 35 seconds. The happy music chosen was track three from the Band of Brothers soundtrack (see appendix C), entitled Suite Two (Kamen, 2001). It was of 8 minutes and 30 seconds duration. The neutral music piece was the opening movement of La Mer by Claude Debussy (1905) entitled “de l’aube à midi sur la mer” lasting nine minutes (see appendix C). This passage was also used as a neutral music condition by

Martin and Metha (1997). The music stimuli were presented via MP3 CD from desktop computer with headphones.

Apparatus

Adinstruments Powerlab 26/T biofeedback unit was utilised to record the heart rate and electrodermal skin conductivity of participants. ECG was recorded using three disposable Ag/AgCl pregelled electrodes in a modified lead configuration. A sample rate of 500 per second was recorded for the baseline and music listening stages. LabChart Reader version 7.3.4 was used to extrapolate the amplitude for both stages and calculate mean beats per minute (BPM) recordings. Electrodermal skin conductance level was also recorded using the Powerlab biofeedback unit; electrodermal electrodes attached to two fingers to record the skin conductance level. The average recordings for the baseline and music listening periods were extrapolated and the mean galvanising skin response (GSR) was calculated on LabChart Reader. The software and music were run on two HP Compaq microtower d240 desktops with 2.66 ghz processors. The music was run on a Windows XP operating system through the CD drive. The headphones used during the experiment were Radiopaq duo noise cancelling headphones.

Procedure

The experiment was conducted on an individual basis in the biometrics lab in DBS Balfe St. Upon entering the lab the participant was instructed to sit in front of the computer to be used for the experiment. The participant was firstly instructed to read and sign the information consent form (see appendix A). They were informed that the experiment was investigating the perception of emotion in music and the listener's subjective and physiological responses to it, but were blind of what condition they were assigned to.

After signing the consent form, participants completed the PANAS questionnaire to establish their general affect valence. The headphones were then put on to avoid obtrusion with the electrode wires following their attachment. The ECG negative electrode was attached to the inside wrist of the participant's left arm if right hand dominant and vice versa for left handed participants. The earth electrode was attached to the inside of their left elbow. The positive electrode was applied to the inside right elbow for right handed participants and the opposite for left handed individuals. The GSR electrodes were positioned on the left hand palm side up for right handed participants and on the opposite hand if left handed. One GSR electrode was applied to the middle finger above the knuckle and attached snugly. The second electrode was attached to the baby finger in the same position. Participants were instructed to relax and sit comfortably in the chair with their hands on the desk in front of them. They were requested to avoid sudden or jerky movements. Once settled a new Labchart file was opened on the experimenter's desktop setting adjusted in order for BPM and GSR recording to be initiated. The music stimulus for the relevant condition was started after 60 seconds to permit a baseline reading to be established. Participants were instructed to close their eyes and listen to the music passage and try focus on it. The monitor of the computer playing the recording was switched off to remove the possibility of visual cues. After listening to the recording the recording was stopped and the participant file saved; all electrodes and the headphones were removed from the participant.

The participant then completed the GEMS questionnaire followed by the demographics and emotion perception questionnaire. Participants allocated to the sad music condition were offered the opportunity to listen to the music from the happy condition as a debriefing method to ensure that they did not leave the experiment in an unpleasant emotional state. All participants were debriefed after completion of the experiment as to the nature of the experiment and the condition they were assigned to. Participants were thanked for their participation and were offered the opportunity to follow up if they had any questions or were interested in receiving the general findings of the experiment.

Results:

Data was analysed using SPSS (Statistical Package for Social Sciences) version 18.0 according to APA Publication Manual 6th edition (American Psychological Association, 2010).

Existing Between-Groups differences:

In order to confirm recorded physiological, perceived, and felt emotional responses reflected the hypothesized changes in the participants' emotional states, one-way ANOVAs were conducted to analyze the results of the PANAS administered before the experiment (see Table 1 for descriptive statistics). PANAS ratings demonstrated no main effect of condition, confirming mood differences existed between the groups prior to listening to the music. $F(2, 87) = .23$, $p = .798$ not significant for positive affect. The Negative PANAS scores were not statistically significantly different between the three music conditions $F(2, 87) = .99$, $p = .375$

Table 1: *Descriptive Statistics for Mean Positive and Negative PANAS scores by condition:*

Group	*M*	*SD*	*N*
Positive PANAS scores			
Sad	34.37	6.46	30
Happy	33.33	6.54	30
Neutral	33.33	7.58	30
Total	33.68	6.82	90
Negative PANAS scores			
Sad	18.53	7.31	30
Happy	20.00	7.91	30
Neutral	17.53	4.86	30
Total	18.69	6.82	90

Note: *M* = Mean; *SD* = Standard Deviation; *N* = Sample size

A one-way between groups ANOVA was conducted to investigate that there was no existing difference in BPM baseline scores between groups prior to listening to the music (see table 2 for descriptive statistics). The BPM baseline mean scores were not statistically significantly different between the three music conditions indicating no main effect of condition, $F(2, 87) = .93$, $p = .400$ Therefore the H_0 was accepted.

Table 2: *Descriptive Statistics for Mean Baseline BPM by condition:*

Group	*M*	*SD*	*N*
Sad	71.04	14.10	30
Happy	66.75	12.55	30
Neutral	67.19	13.53	30
Total	68.33	13.40	90

Note: *M* = Mean; *SD* = Standard Deviation; *N* = Sample size

A one-way between groups ANOVA was conducted to investigate that there was no existing difference in GSR baseline scores between groups prior to listening to the music (see Mean Table 3). No main effect of condition was demonstrated as GSR baseline mean scores were not statistically significantly different between the three music conditions $F(2, 87) = .54$, $p = .583$. Therefore the H_0 was accepted.

Table 3: *Descriptive Statistics for Mean Baseline GSR by condition:*

Group	*M*	*SD*	*N*
Sad	3.15	3.73	30
Happy	2.32	2.50	30
Neutral	2.73	2.88	30
Total	2.73	3.07	90

Note: *M* = Mean; *SD* = Standard Deviation; *N* = Sample size

Hypothesis One:

One-way between-groups ANOVAs were conducted to investigate hypothesis one that there will be a significant difference between conditions in: a) physiological response (mean change in BPM and GSR between baseline and music listening); b) perceived emotion; c) felt emotion (sublimity, vitality, unease).

A one-way between-groups ANOVA was carried out to examine the effect of listening to music on heart rate, measured by the change in BPM recordings from baseline for each music condition. Tests of normality indicated no outliers and the data was normally distributed for the sad music group, as assessed by boxplot and Shapiro-Wilks test ($p > .05$), respectively. The happy and neutral groups both showed extreme outliers (cases 45 and 86) and Shapiro-Wilks ($p < .05$), however the skewness values were less than 2.00, as ANOVA is a robust parametric test, it was conducted (Kline, 2005). There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance ($p = .134$) based on the mean. The BPM change mean scores increased from the sad music condition ($M = .62$, $SD = 6.82$) to the happy music condition (M = 4.63, SD = 12.65) and decreased to the neutral music condition ($M = 2.25$ $SD = 13.83$), in that order. Changes in BPM mean scores were not statistically significantly different between the three music conditions $F(2, 87) = .92$, $p = .403$ (see ANOVA Table 4). Therefore the H_0 was accepted.

Table 4: *ANOVA summary table for Mean BPM change by Music Condition:*

Source	*SS*	*df*	*MS*	*F*	*p*
Between Groups	243.67	2	121.84	.92	.403
Within Groups	11531.53	87	132.55		
Total	11775.206	89			

Note: (*SS* = Sum of Squares; *df* = degrees of freedom; *MS* = Mean Square)

A one-way between groups ANOVA was carried out to examine the effect of listening to music on skin conductance, measured by change in GSR recordings from baseline for each music condition. Tests of normality showed no outliers and the data was normally distributed for all group as assessed by boxplot and Shapiro-Wilks test (p >.05), respectively. There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance (p = .900) based on the mean. The GSR change mean scores decreased from the sad music condition (M = .95, SD = 3.36) to the happy music condition (M = 1.95, SD = 1.82) and increased to the neutral music condition (M = 1.82, SD = 3.26), in that order. The changes in mean GSR scores were not statistically significantly different between the three music conditions F(2, 87) = .82, p = .445. Therefore the H_0 was accepted.

A one-way between groups ANOVA was carried out to examine the effect of listening to music on the emotionality of the perceived by the listener, measured by self-report questionnaire on emotion perception. Tests of normality showed no extreme outliers in the boxplot, Shapiro-Wilks test (p <.05), however skewness was less than 2.00. There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance (*p* = .323) based on the mean. The perceived emotion increased from the sad music condition (*M* = 2.77, *SD* = 1.07) to the happy music condition (*M* = 5.43, *SD* = .94) and decreased to the neutral music condition (*M* = 4.53, *SD* = 1.33), in that order. The perceived emotion scores were statistically significantly different between the three music conditions $F(2, 87) = 43.59$, $p < .001$. Therefore the H_A was accepted. Despite reaching statistical significance the effect size was quite small (eta squared = .02), as the mean difference between-groups was small. Tukey post-hoc analysis revealed that the perceived emotion mean score statistically significantly different between the happy (*M* = 5.43, *SD* = .94) and sad conditions (*M* = 2.77, *SD* = 1.07, p < .001) and happy and neutral music conditions (*M* = 4.53, *SD* = 1.33, *p* =. 007). Sad and neutral music conditions also had significantly different mean scores for perceived emotion ($p < .001$).

A one-way between groups ANOVA was carried out to examine the effect of listening to music on felt emotion, measured by Sublimity GEMS scores for each music condition. Tests of normality showed no outliers and the data was normally distributed for all group as assessed by boxplot and Shapiro-Wilks test ($p > .05$), respectively. There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance (*p* = .528) based on the mean. The sublimity scores increased from the sad music condition (*M* =15.33, *SD* = 3.77) to the happy music condition (*M* = 15.87, *SD* = 3.22) and decreased to the neutral music condition (*M* = 14.80, *SD* = 3.89), in that order. The sublimity scores were not statistically significantly different between the three music conditions $F(2, 87) = .64$, $p = .528$. Therefore the H_0 was accepted.

A one-way between groups ANOVA was carried out to examine the effect of listening to music felt emotion, measured by vitality GEMS scores for each music condition. Tests of normality showed no outliers and the data was normally distributed for all group as assessed by boxplot and Shapiro-Wilks test ($p > .05$), for happy and neutral but ($p > .05$) for sad, however skewness was less than 2.00. There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance ($p = .293$) based on the mean. The Vitality scores were statistically significantly different between the three music conditions $F(2, 87) = 9.16$, $p < .001$. Therefore the H_0 was accepted. A large effect size was found (eta squared =.17). Tukey post-hoc analysis revealed that the listener reported significantly more vitality in the happy music condition ($M = 6.40$, $SD = 1.94$) than the sad ($M = 4.20$, $SD = 1.96$, $p > .001$) and the sad significantly lesser than the neutral music condition ($M = 5.87$, $SD = 2.32$, $p = .007$), but there was no significant difference between the happy and neutral conditions ($p = .582$).

A one-way between groups ANOVA was carried out to examine the effect of listening to music on felt emotion, measured by unease GEMS scores for each music condition. Tests of normality showed no extreme outliers. Data was not normally distributed for group as assessed by boxplot and Shapiro-Wilks test ($p < .05$), however skewness was less than 2.00. Homogeneity of variances was not met as assessed by Levene's Test of Homogeneity of Variance ($p = .003$) based on the mean. The unease scores were statistically significantly different between the three music conditions $F(2, 87) = 16.56$, $p < .001$. Therefore the H_A was accepted. A large effect size was found (eta squared =.28. Tukey post-hoc analysis revealed that the listeners reported feeling significantly more unease in the sad music condition ($M = 5.10$, $SD = 2.04$) than the happy ($M = 2.70$, $SD = .99$, $p > .001$) and the sad significantly more than the neutral music condition (*M* = 3.43, *SD* = 1.76, $p = .004$), but there was no significant difference between the happy and neutral conditions ($p = .125$).

Hypothesis Two

Multiple regressions were used to test second hypotheses' predictions that the physiological responses (BPM, GSR change) would be significantly correlated with the felt emotion responses (sublimity, vitality, unease). Assumptions of linearity, independence of errors, homoscedasticity, multicollinearity, and normality of residuals were adhered to; however Mahalanobis, Cook's Distance and Leverage points were violated. A constant one value greater than the largest value was added to the BPMchange variable and the square root was calculated the assumptions rechecked, however they remained violated. According to Kline (2005) parametric tests are fairly robust to non-normality; however the variables did not statistically significantly predict sublimity ($F(2, 87) = .64$, $p = .532$), Vitality ($F(2, 87) = .01$, $p = .989$) or Unease ($F(2, 87) = .36$, $p = .700$).

Hypotheses Three

Multiple regressions were used to test for the third hypotheses that there would be a correlation between PANAS scores, subjective feeling (unease, sublimity, vitality) and perceived emotion responses.

A multiple regression was used to predict unease scores from sad music condition, negative PANAS scores and perceived emotion. The assumptions of linearity, independence of error, homoscedasticity, unusual points and normality of residuals were met. These variables statistically significantly predicted unease ($F(3, 86) = 19.36$, $p < .001$, $R^2 = .38$). Only perceived emotion added statistically to the prediction, (β = -.516, $p < .001$, 95% *CI* = -.902 - -.359).

A multiple regression of neutral music, PANAS scores and perceived emotion was employed to predict sublimity. The assumptions of linearity, independence of error, homoscedasticity, unusual points and normality of residuals were met. Sublimity was statistically significantly predicted by these variables ($F(4, 85) = 2.52$, $p = .047$, $R^2 = .06$) with the model accounting for 6% of the variance. Only positive PANAS scores added significantly to the prediction, (β = .240, $p = .022$, 95% *CI* = .019 - .236).

A multiple regression was conducted to predict vitality from positive PANAS scores, perceived emotion and happy music condition. The assumptions of linearity, independence of error, homoscedasticity, unusual points and normality of residuals were met. These variables statistically significantly predicted vitality ($F(3, 86) = 9.87$, $p < .001$, $R^2 = .23$), with the model explaining 23% of the variability of vitality. Both perceived emotion (β = .356, $p = .002$, 95% *CI* = .196 - .827) and positive PANAS scores significantly added to the prediction (β = .268, $p = .005$, 95% *CI* = .027 - .150).

Discussion:

The aim of this experiment was to examine the effect of differing emotionality of music on the perception of the emotion expressed by the music and the subjective feeling, physiological responses to it differentiating for mood. It was anticipated that a subtle distinction would exist between the participants' experience of emotion listening to the excerpt and their judgement of the emotion being expressed. Initial analyses were conducted to test for individual differences between groups on PANAS scores, baseline BPM and GSR. No significant differences were found between groups indicating any differences were inter-individual. However, random allocation to conditions attempted to reduce these effects. The PANAS was used as it is a measure of affective state, and Konečni, (2008) highlighted the failure of many previous researcher to distinguish between affective state, i.e. mood, and emotion This is an important distinction, as mood is affective states that are less intense than emotions and last several hours to days (Juslin & Sloboda, 2010). As mood varies throughout the day, efforts were made to split the participants evenly into afternoon and evening sessions and ensuring equal numbers in each group. Based on the findings of previous research moods more likely to be a moderator of emotional response to music than the other way round (Vuoskoski & Eerola, 2012).

It was firstly hypothesized that there would be a significant difference between the three levels of independent variable manipulated in the experiment (sad, happy, neutral music) a) physiological response (mean change in BPM and GSR between baseline and music listening); b) perceived emotion; c) felt emotion (sublimity, vitality, unease). One-way ANOVAs conducted to investigate the effect of differing the emotion expressed by the music between the groups indicated that there was no main effect on BPM change and GSR change.

Therefore the null hypothesis was accepted. Discrepancies exist amongst previous findings for the direction of BPM and GSR change due to the valence of the music stimulus, but it was anticipated that arousal levels would be correlated with the intensity and valence of the musical emotions, but was unsupported in the results (Krumhansl, 1997; Nyklíček, Thayer, & Van Doornen, 1997). For example, sad music is characterised by slow, muted and slightly discordant sounds, whereas happy music was of medium tempo, loud, and concordant (Juslin & Laukka, 2008). In an attempt to control for individual or sex differences between the participants in the physiological results, difference scores were calculated for the BPM and GSR by subtracting the mean Baseline BPM and GSR recordings from the mean BPM and GSR recordings while listening to the music (Miu & Baltes, 2011).

Although there were no statistically significant differences in the mean BPM and GSR between baseline and music listening recordings, there was a greater difference in the BPM scores for the happy music condition compared to baseline than in both the sad and neutral conditions. The neutral music condition also demonstrated a greater change in BPM recordings than for the sad condition. Krumhansl (1997) reported weak correlations between continuous emotional responding and physiological recordings during music listening. Greater physiological changes were recorded for sad music conditions as opposed to happy music in this study. Although much investigation has been conducted examining the physiological markers of emotional responding to music there is inconsistent findings across studies (Barrett and Wager, 2006).

Similarly, the null hypothesis was accepted for the change in GSR scores as a result of the music conditions, as there was no statistically significant difference between groups. However, the change in GSR reflected the trend of the BPM change, whereby the greatest change from baseline occurred in the happy condition, followed by the neutral and then considerably less so in the sad condition. A limitation of this study, is that while it investigated the change in scores, it was unable to account for the direction of the change, as scores had to be converted to allow for analysis. Amendments to the method of normalising the data for use are recommend for future research, perhaps applying spectral analysis fourier transformations as per Miu & Baltes (2012).

There was a statistically significant main effect between the conditions in the perceived emotion expressed by the music. The higher ratings of happiness as the perceived emotion reflected the happy music condition. The neutral music condition perceived ratings reflected the intended emotion, as did the sad. Despite small effect size, there was a slight variation in the means between conditions with neutral having the lowest mean score for sublimity, even though the subscale markers has been demonstrated by other studies to correlate with milder feelings of emotion characteristic of neutral music. However, this may serve to demonstrate the association between sad music and nostalgia and tenderness or other subscales of sublimity. Much research has investigated the counterintuitive phenomenon of the enjoyment of sad music (Hunter, Schellberg & Schimmack, 2010). This calls into question the ability of music to induce emotion in the listener, if sad music is not correlated with subjective feelings of sadness (Konečni, 2008). Interestingly, there was a substantial effect size for the main effect of the conditions on unease scores, with a significantly higher rating for unease in the sad music condition. This appears to contradict the findings of the sublimity variable. Or, conversely, it could extend Zentner's (2010) argument of the aesthetic and blended nature of musically induced emotions that they are nuanced and do not pertain to one category or dimension but rather a pattern of emotions. Vitality was statistically significantly different between groups; therefore the alternative hypothesis was accepted. Vitality scores were highest for the happy condition, and lowest for the sad condition as anticipated. Joyful activation, the subscale of vitality is described as the action tendency to dance, and this would be unexpected from the sad music stimulus (Zentner, Grandjean & Scherer, 2008).

The second hypothesis that was investigated was that there would be a statistically significant association between the changes in the physiological recordings and the subjectively felt emotions. The null hypothesis was accepted for each of the multiple regression correlations, indicating that subjectively felt emotions cannot be predicted by changes in arousal levels in response to music. The ability to attribute changes in physiological arousal levels to changes in emotionality of musical stimuli difficult to empirically support. While arousal levels may vary it is not possible to state that this is as a result of the music changes (Juslin & Sloboda, 2010). It is important to develop future research to incorporate neuroimaging techniques to attempt to localise the neural correlates of emotional response to music to better understand this faculty.

It was also hypothesized that there would be a significant correlation between the PANAS scores and the felt emotions and perceived emotions. Multiple regressions were utilised to predict the felt emotion responses from the perceived emotion and relevant PANAS score. For unease, the alternative hypothesis was accepted that there was a correlation between the variables, however only perceived emotion was a significant predictor of unease. One interpretation may be that people experiencing a lower affective state may interpret the emotion in the music as more sad than individuals in a neutral or happy affective state (Vuoskoski & Eerola, 2012). However, it does not explain why the PANAS scores did not significantly correlate, therefore it is more supportive of the emotional contagion hypothesis, as it suggests that an induced emotion will reflect the expressed emotion that is perceived. This would call into question the episodic or musical expectancy approaches from Cognitivist theory. However, an important confounding variable to consider is the contextual factor, whereby the artificial laboratory environment, and the unfamiliar experimenter selected passage may inhibit some of the mechanisms that may operate in a more naturalistic environment, Zentner (2010) highlighted the significant physiological markers of arousal chills that were experienced by concert goers.

Similarly, sublimity was correlated with positive and negative PANAS scores, the neutral music condition and perceived emotion, therefore rejecting the null hypothesis. In this instance, the positive PANAS score was the only predictor of sublimity. Likewise, vitality was significantly correlated with perceived emotion, happy music, and positive PANAS scores. Perceived emotion most significantly predicted vitality, but positive PANAS scores were also a predictor. Felt emotion was classified by GEMS scale blended emotions (sublimity, vitality, unease). Sublimity was not statistically significantly different between groups; therefore the null hypothesis was accepted. It is interesting to note that the perceived and felt emotional responses have demonstrated the most significant correlations across the analyses. Further analyses are necessary in order to determine the causal factor and the direction of the association between the conditions, as in this experiment due to the nature of the perceived emotion questionnaire structure it was not possible to perform alternative analyses.

Self-report questionnaires were used as they permit access to the subjectively felt aspect of emotion, but the intensity of the emotions may not be accurately represented by the descriptions provided for the rating scales. Similarly, providing the rating after listening to the excerpt and completing two separate questionnaires may not be the most accurate way of testing the emotion responses. Retrospective rating of the affective response coupled with forced choice responses may not be an accurate representation of the fluctuation or the blend of emotions that are experienced during the course of the music passage (Zentner, 2010). Reponses provided post-listening are more easily collected and analysed but may only provide the average emotional rating. The forced choice response categories utilised may not have included the description of the emotion that the participant would use but due to the nature of this process they have to select one of the provided options. However, closed ended questions provide quantifiable data that can be analysed more easily than open ended qualitative responses (Schimmack et al., 2002).

Currently there are two models of emotion theory that underpin the method of self-report implemented: Ekman's (1971) basic/categorical emotion theory and Russell's (1980) dimensional approach. Dimensional studies focus on the valence and/or arousal dimensional concepts, whereas the categorical approach categories responses by the basic emotions e.g. sadness. A benefit of the categorical over the continuum approach is that it permits the experimenter to examine mixed responses i.e. high sad and high happy responses, whereas this is not facilitated by the dimensional structure where the scale ranges from sad to happy (Juslin & Sloboda, 2010), as was employed here in the perceived emotion scale.

The performance of the music is an important mechanism for expressing the emotionality of the piece. The removal of visual stimuli from this experiment controlled for the influence of visual cues of emotion from the performance. However, this may account for the subtle responses of participants as for example the emotion being conveyed in the music can be manipulated by the facial expressions and gestures of the performer (Thompson, Russo & Quinto, 2008). Davidson (1994) reported that emotion expressed in the music was more correctly identified by both musician and non-musician participants exposed to audiovisual music performance and visual only performance rather than audio only, highlighting the strong influence of visual cues in music emotion perception. Conflicting reports exist whereby visual only was the weakest cue for the perception of emotion (Vines, Krumhansl, Wanderley, Dalca, & Levitin, 2011).

Finally, liking rating, music genre preferences and personality factors were not measured in this experiment and there is increasing evidence of the mediating role these factors play in the perceived and felt emotion from music. Many current studies have incorporated these factors and it has even been postulated that if the music stimulus is mismatched with the preferred genre of the listener it will mute and possible negatively influence their response (Garrido & Schubert, 2011). It is recommended for future research to incorporate measures or conditions investigating these factors.

In conclusion, there was a statistically significant difference between the sad, happy and neutral music conditions for perceived emotion and GEMS vitality, sublimity and unease scores. This demonstrates that differing emotional valence of music is capable of evoking an emotional response in the listener. Additionally, a significant correlation was found between the PANAS scores and the perceived and felt emotion according to condition. This supports the hypothesis that affective valence is a moderating factor in the induction of emotional responses. No statistical support was found for the physiological correlates of arousal being linked to emotion. These findings add further to the literature that demonstrates the ability of emotion to evoke affective responses in individuals. The utilisation of music as a therapeutic mechanism for individuals with affective disorders is an emerging area of research with exciting prospects for psychological improvements (Thaut, 2010).

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Appendices

A: Information Consent Form:

Emotional Response to Music experiment

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Supervisor: Dr. Patricia Frazer, Dublin Business School, Psychology Department

<u>Information about the experiment and consent form</u>

Thank you for your interest in this study. In this experiment, you will be asked to listen to an audio clip of a music excerpt and to indicate the emotional response that you feel after listening to it. Electrodes will also monitor your heart rate and skin conductance responses while listening to the music. This will be indicated to you by the experimenter.

You are free to withdraw from this study at any time without any penalty. If you have any questions, please do not hesitate to ask for clarification.

By signing below you agree that:

1. The experimenter has adequately explained the task to you and you do not have any further questions.
2. You are free to withdraw at any time without penalty.
3. Your data from this study will be kept confidential and stored anonymously. We will not be able to identify your data or associate your data with your name.

4. Your data will be grouped with other participants and these group results may be presented in scientific papers and conferences.

Please sign below to confirm your consent for your data to be included in this study as per the conditions above:

Signature: …………………………………. Date: ……………………………

If you have any questions or would like to receive a copy of the results of the study please feel free to contact me on [redacted].

I do not anticipate that the experiment will cause any distress, however please do not hesitate to contact the Samaritans helpline on 1850 60 60 90 if you feel in any way affected.

B. PANAS Questionnaire

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate to what extent you have felt this way over the past week.

1	2	3	4	5
Very Slightly/Not at All	A Little	Moderately	Quite a Bit	Extremely

_________ 1. Interested

_________ 2. Distressed

_________ 3. Excited

_________ 4. Upset

_________ 5. Strong

_________ 6. Guilty

_________ 7. Scared

_________ 8. Hostile

_________ 9. Enthusiastic

_________ 10. Proud

_________ 11. Irritable

_________ 12. Alert

_________ 13. Ashamed

_________ 14. Inspired

_________ 15. Nervous

_________ 16. Determined

_________ 17. Attentive

_________ 18. Jittery

_________ 19. Active

_________ 20. Afraid

C. Links to music passages utilised in the experiment

Sad Music Stimulus: Discovery of the Camp, Band of Brothers sound track (Kamen, 2001) :

http://www.youtube.com/watch?v=bmdFmmyXlQk

Happy Music Stimulus: Suite Two, Band of Brothers sound track (Kamen, 2001): http://www.youtube.com/watch?v=ag8KbhbCKXI

Neutral Music Stimulus: De l'aube a midi sur la mer, an excerpt from La Mer (Debussy, 1905):

http://www.youtube.com/watch?v=9X_V4us1o_E

D. GEMS-9:

Instructions

When providing your ratings, please describe how the music you listen to makes you *feel* (e.g., this music makes me *feel* sad). Do not describe the music (e.g., this music is sad) or what the music may be expressive of (e.g. this music expresses sadness). Keep in mind that a piece of music can be sad or can sound sad without making you feel sad. Please rate the intensity with which you *felt* each of the following feelings on a scale ranging from 1 (*not at all*) to 5 (*very much*).

1	**2**	**3**	**4**	**5**
Not at all	Somewhat	Moderately	Quite a lot	Very Much

1. **Wonder** Filled with wonder, Dazzled, Moved	**1**	**2**	**3**	**4**	**5**
2. **Transcendence** Fascinated, Overwhelmed, feelings of transcendence and spirituality	**1**	**2**	**3**	**4**	**5**

3. **Power** Strong, Triumphant, Energetic	**1**	**2**	**3**	**4**	**5**
4. **Tenderness** Tender, Affectionate, In love	**1**	**2**	**3**	**4**	**5**
5. **Nostalgia** Nostalgic, Dreamy, Melancholic	**1**	**2**	**3**	**4**	**5**
6. **Peacefulness** Serene, Calm, Soothed	**1**	**2**	**3**	**4**	**5**
7. **Joyful Activation** Joyful, Amused, Bouncy	**1**	**2**	**3**	**4**	**5**
8. **Sadness** Sad, Sorrowful	**1**	**2**	**3**	**4**	**5**
9. **Tension** Tense, Agitated, Nervous	**1**	**2**	**3**	**4**	**5**

E. Experimenter designed demographics and emotion perception questionnaire

Section A: Demographics Questionnaire:

Please answer the following questions: (Please circle the answer that most applies to you)

1. ***Gender:***

   Male Female

2. ***Age bracket*:**

   18-24 25-29 30-34 35-39 40-49 50-64 65+

3. ***Nationality:***

   Irish Rest of World

4. ***Musical experience:***

Professional Musician Semi- Professional Musician Amateur/Non- musician

Section B: Emotion expressed in the music:

Please indicate whether you perceived the emotion expressed in the music as: (please circle the appropriate number)

Very Sad	Sad	Moderately Sad	Neutral	Moderately Happy	Happy	Very Happy
1	2	3	4	5	6	7