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Why do people get chills in response to music? Most people report feeling chills — experienced as goose bumps, shivers down the spine, or hair standing on end — at least sometimes when listening to music, but a small minority of people say they've never had this experience. Past work indicates that personality, experience, and engagement in music are partially responsible for individual differences in the experience of chills in response to music, but there is still significant variance in chills that is unexplained. In the present study, experience sampling methods were used to better understand the within-person variability in the experience of chills. Eighty-nine undergraduates completed surveys of Big Five personality traits and music preferences, habits, and experience. For one week, participants responded to multiple daily surveys asking about activities, emotions, and environment, with an emphasis on music listening and chills. Hierarchical linear modeling was used to estimate several models of the variability in chills. Several factors of music listening were examined as potential predictors of chills, including the location, involvement of friends, music choice, structural components of the music, purpose of music listening, and concurrent activities. Of these, music that had special meaning and music that was instrumental had significant main effects on the occurrence of chills, as did taking more music classes and scoring high in facets of neuroticism and openness to experience. In addition, neuroticism and openness facets significantly interacted with contextual aspects of music listening, such as music familiarity, paying close attention to the music, and listening on headphones. Directions for future theorizing are discussed.

LISTENING BETWEEN THE NOTES: PERSONALITY,

LISTENING CONTEXT, AND AESTHETIC CHILLS

IN EVERYDAY MUSIC LISTENING

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

In research on music and aesthetic emotions, chills are hot. Within the last five years, psychologists have studied the chill effect (i.e., goose bumps, a sensation of hair standing on end, or shivers down the spine) that people get in response to music from many different perspectives. Recently, researchers have examined how chills are affected by lyrics versus melodies (Ali & Peynircioglu, 2006), emotional and aesthetic priming (Konečni, Wanic, & Brown, 2007), meaningfulness of music on chills (Craig, 2009), personality traits (Nusbaum & Silvia, 2011; Rawlings & Leow, 2008; Silvia & Nusbaum, 2011), and music structure (Grewe, Kopiez & Altenmüller, 2009; Grewe, Nagel, Kopiez & Altenmüller, 2007; Nagel, Kopiez, Grewe, & Altenmüller, 2008; Sloboda, 1991). Although the scope of recent research on chills elicited by music is quite wide, it seems to be missing a key element, as confusion about aesthetic chills still persists.

Chills: An Aesthetic Emotion

In the field of aesthetics research, unusual aesthetic emotions — the feelings, thoughts, attitudes, or states of mind associated with how we perceive aesthetic things — are curious things. Although other, more common emotions such as liking and pleasingness have been studied extensively by aesthetics researchers, these more unusual feelings, like chills, crying, and awe, are perplexing, and often avoided in discussions of aesthetic emotions. As such, most work in the area follows Berlyne's (1971) tradition, which revolves around people's sense of pleasingness or liking — and conversely people's disliking — of aesthetic objects (Armstrong & Detweiler-Bedell, 2008; Leder, Belke, Oeberst, & Augustin, 2004). In recent years, however, the field has become less resistant to the more complex emotions like interest, confusion, surprise, and anger (see, for example, Silvia, 2009) as aesthetic experiences. Yet, researchers are still puzzled by the unusual emotions — awe, feeling moved or touched, crying, and chills or thrills — that are on the fringe of aesthetics work.

Perhaps because of their easily identifiable nature as a feeling of goose bumps, hair standing on end, or shivers on the scalp or down the spine during an aesthetic experience, aesthetic chills have arguably become the focus of most of the research about these unusual emotions. Recent research in the area has focused on physiological and music-structural correlates of chills (Craig, 2005; Guhn, Hamm, & Zentner, 2007; Nagel et al., 2008), and the usefulness of chills as an indicator of emotions (Gabrielsson, 2006; Grewe et al., 2009; Grewe et al., 2007). However, the literature remains scattered, leaving researchers without a cohesive theoretical explanation of why and when people experience chills.

Theories of Aesthetic Chills

To date, only two researchers have theorized about aesthetic chills. The first theory, Konečni's (2005) Aesthetic Trinity Theory — which also includes feelings of being moved and being in awe — addresses aesthetic chills as the entry-level "peak aesthetic experience." Konečni hypothesizes that people get chills when listening to music because music induces emotion by forcing people to recall “memories and associations regarding powerful real-world events” (Konečni, 2008, p. 123). This theory uses an experimental philosophy approach to explain the “sublime” aesthetic peaks, and is primarily concerned with beauty and goodness.

However, there are two problems with this theory. First, the chills that occur while listening to music are not likely to be associated with only beautiful and good real-world events. The abstractness of what type of event or how the event is recalled makes Konečni’s idealized theory difficult to interpret in terms of real-world experiences of music that elicit chills. In addition, it is not clear in this model whether music in general primes people to recall various events that elicit chills, or whether there is some memory associated with chills that is tied explicitly to the music and brings about chills as in a classically conditioned response. In the former scenario, we would expect that listening to music is associated with mind wandering, which is, in turn, associated with positive emotions. But contrary to this expectation, past research on mind wandering has found that people tend to spend about a third of the time mind wandering throughout the day, and that the mind tends to wander more often when a person is bored, stressed, or doing something unpleasant, and less often when a person feels happy, when they are concentrating, and when they are doing something enjoyable (Kane, et al., 2007). Additionally, in the latter scenario, if a piece of music evokes chills via a conditioned response, then people should get chills every time they hear that particular song. However, the relative infrequency of people getting chills while listening to music (Silvia & Nusbaum, 2011) seems to suggest that this is not the case.

A second problem with Konečni's theory is that the Aesthetic Trinity Theory ignores between-person differences that may contribute to our understanding of who gets chills while listening to music and in what situations. In previous research, individual differences in personality and music experience have emerged as factors that substantially predict how often people get chills (Nusbaum & Silvia, 2011; Silvia & Nusbaum, 2011). But because Konečni's theory is limited to music that recalls memories of real-world events, there isn't a lot of flexibility to include individual differences in predictions about aesthetic chills.

The second theory takes an evolutionary approach to explaining chills and is founded in the field of musicology. Huron (2006; Huron & Margulis, 2010) developed the Imagination–Tension–Prediction–Response–Appraisal (ITPRA) theory, which describes the chill response to music as a reaction to the confirmation or contradiction of our expectations about structures and characteristics of music. In this theory, unexpected changes in music (i.e., entrance of a new instrument or voice, changes in tempo, pitch, or volume) surprise us and elicit a physiological response, which in the past alerted our ancestors to impending "death-by-lions," but today we experience as chills. It's important to note, however, that although Huron describes chills in terms of unexpected changes in music, the music doesn't have to be novel for the listener in order to elicit chills — rather, the changes are unexpected in the context of music structures leading up to the chills-inducing change. From a theoretical standpoint, studying aesthetic chills through the psychology of expectation makes sense: it brings together our understanding of emotions induced by music (Huron, 2006; Huron & Margulis, 2010; Konečni, 2008) and chills elicited by music (Grewe et al, 2009; 2007; Blood & Zatorre, 2001) to help explain how music can produce a physiological response like chills.

Although Huron's ITPRA theory is a more apt explanation of aesthetic chills that occur in response to music, neither of the aforementioned theories are quite fit to explain the conundrum of individual differences in chills. In recent studies on the individual differences in music preference and the experience of chills, it's apparent that there is considerable variability in the frequency with which people experience chills. Silvia and Nusbaum (2011), for example, found that although most people reported having chills occasionally, some people said that they always get chills when listening to music, and a small but notable group of people (about 8% of the sample) reported never having experienced aesthetic chills. In studies like Grewe et al. (2009) in which all participants are exposed to the same music (and thus, musical structures), what could explain the third of the sample who reported no chills at all? Given these findings, it is apparent that current theories could be expanded on to include other person or situation factors — whether on their own or combined in interactions — that play an important role in the chills experience.

Chills and Personality

One line of research on chills attempts to explain differences in how often people experience chills while listening to music by examining the influence of personality factors. In general, researchers tend to use the Five Factor Model of personality (McCrae & John, 1992) to explore the effect on chills occurrences. This model includes five broad personality traits (or domains) — openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism — that are further divided into six facets within each domain. Because a person high in openness to experience is typically fantasy-prone, highly imaginative, appreciative of aesthetics, and sensitive to emotions, it seems likely that this personality trait in particular might predict the frequency with which people experience chills in response to music (McCrae, 2007).

Indeed, recent studies conducted by Nusbaum and Silvia (2011; Silvia & Nusbaum, 2011) found that openness to experience was the strongest predictor of chills when compared to other personality domains, gender, aesthetic fluency, creative versus uncreative college majors, and fluid intelligence. So what is it about being high in openness to experience that leads people to get more chills while listening to music?

Although one study (Nusbaum & Silvia, 2011) did identify some mediators of the effect of openness on chills — chiefly, importance of music to people, playing an instrument, and listening to music for more hours during the day — the indirect effects were small, and no other studies have identified mediators of this fairly large relationship. Motivated by studies that identify physiological responses to music structure (such as Benedek & Kaernbach, 2011; Blood & Zatorre, 2001 and Grewe et al., 2007, 2009) the same study tested whether the music genre that people prefer mediates the openness–chills relationship. Interestingly, Nusbaum and Silvia (2011) found that despite diverse complexity in the structures of different music genres, and the tendency for high openness people to prefer more complex music, genre preference — what type of music people like to listen to the most — was not a significant mediator of the relationship between openness and chills.

Another way to examine this effect involves other aspects of individual differences that are associated with being high in openness to experience, such as absorption, mind wandering, and unconventionality. Earlier studies have found that absorption (the tendency to become immersed in an activity) is significantly correlated with openness to experience — especially with the fantasy, aesthetic appreciation, and sensitivity to feelings facets (McCrae & Costa, 1985) — and with liking a variety of music samples (Rhodes, David, & Combs, 1988). If people high in openness do become more absorbed in and focused on that music-listening experience, are they more likely to get chills? Because mind wandering has been linked to working memory capacity, executive control, and mood (Kane et al., 2007; McVay & Kane, 2009; Smallwood, Fitzgerald, Miles, & Phillips, 2009), there is reason to suspect that music listening could be a vehicle for generating aesthetic chills in a wandering mind. Yet, no studies have investigated this potential link between openness to experience and occurrences of aesthetic chills.

Do high openness people have a more unconventional attitude toward experiences? Do they become more absorbed in activities, including listening to music? Do they tend to mind-wander while listening to music? By examining these individual differences, we can begin to understand why it is that people high in openness to experience are becoming more engaged in music listening, and why that leads to getting more chills during that experience.

Expanding on Current Theories

Part of the problem with these theories is the type of study they rely on for data collection. Experimental lab methods can make it difficult to generalize results to more realistic contexts. Most of the time when people experience chills, they aren't sitting in a psychology lab, connected to physiology-monitoring equipment, hovered-over by research assistants, listening to J. S. Bach's *Unser Leben ist ein Schatten* [Our life is a shadow] (as in Grewe et al., 2009). In fact, this set-up is almost never how people choose to listen to music in daily life — and thus, the results can't allow us to infer how the chills experience comes about in everyday music listening.

A second problem with the typical lab-based study on chills and music is the loss of information incurred because people have difficulty recalling the last time they experienced chills. Because chills are fairly infrequent experiences for most people, researchers never know if their results are marred by a spurious correlation with a third variable that the participant either couldn't remember or didn't think to mention. Even for the most diligent diary-keeper, there will be some details of musical encounters that are forgotten — a lamentable loss of information for researchers conducting lab studies. Changing the survey method, however, offers a potential solution to the problems encountered by past work on aesthetic chills elicited by music.

Advocated by Csikszentmihalyi and Lefevre (1989) as a useful method for researching everyday experiences, the Experience Sampling Method (ESM) captures the behaviors, thoughts, and feelings that occur throughout the day. For an extended period of time (usually a week or two), people are surveyed multiple times per day to assess variation that occurs in people's everyday lives. In this way, researchers can observe both the activities that occur only once or twice a week or only on specific days, as well as how those behaviors, thoughts, and feelings fluctuate given many other variables. This is a particularly useful method for studying the experience of chills in response to music, as (1) it avoids the problems with ecological validity associated with lab studies, and (2) it catches the idiosyncrasies of situations in which people experience chills that they may not remember weeks or months later when asked to recall the experience on a survey. The low base-rate of chills people experience could potentially cause problems when using this method, but a small study by Sloboda, O'Neill, and Ivaldi (2001) suggests that ESM is a fruitful way to study music experiences in everyday life.

Although more recent work has begun to explore individual differences in how people experience chills (Nusbaum & Silvia, 2011; Silvia & Nusbaum, 2011), these methods still have the same limitations encountered in more traditional studies of the physiological and emotional experience of music and the music structures that elicits chills. ESM capture variables that conventional studies miss. With the inclusion of criteria about everyday experiences, it may be possible to develop a theory about people's experience of unusual aesthetic emotions like aesthetic chills. Ideally, this theory will address the individual differences in frequency of chills, within-person situations that predict chills, and the appraisals that elicit chills from a wide variety of music types.

The Present Study

The present study expanded upon current theories of aesthetic chills elicited by music, by including individual differences in predictions about chills. By using the

Experience Sampling Method, information is made available on a number of variables in the everyday experience of music and chills that are lost to more traditional laboratory survey methods. The inclusion of within-person and between-person variables allowed for a better understanding of the wide variability in people's experience of aesthetic chills. Although the study was descriptive in nature, it was expected that several new predictors of chills would allow for the development of a model of aesthetic chills that improves upon the model introduced in Nusbaum and Silvia (2011), in which people's experience with and engagement in music — rather than music genre and the musical structure associated with it, as predicted by the authors — served as mediators of the personality and chills relationship.

The goals of the present study were to examine individual differences in people's experience of chills while listening to music, and to describe the circumstances in which chills occur. Of particular interest were factors related to music experience and engagement (i.e., how important is music to people, how many instruments people play, how often they listen to music for the sole purpose of listening to it) and situational factors like whether people chose the music, whether the music is playing second fiddle (sorry, I couldn't resist) to another activity, and whether people are listening to music solo or with a group of other people. Essentially, this study was designed to ask who gets chills, and why. With this information, we begin to understand why there is such tremendous variability in people's experience of chills, and also why chills occur in response to music at all.

By using the Experience Sampling Method to study chills, we were able to examine three things: (1) the influence of Big Five personality factors, people's experience with music, and traits like absorption and unconventionality on people's likelihood of experiencing chills, (2) the environmental factors associated with having chills in response to music, and (3) the interaction between personality and environment and its effect on chills. Specifically, we hypothesized that people high in Openness to Experience would experience the most chills overall, and that various personality-environment-music feature interactions would influence people's chills response to music. The first hypothesis mostly followed from earlier findings of the influence of openness to experience on the prevalence of chills (Chamorro-Premuzic & Furnham, 2007; Nusbaum & Silva, 2011; Silvia & Nusbaum, 2011), whereas the second hypothesis was motivated by research showing extreme variability in how people engage and interact with music (Hargreaves & North, 1999; Juslin, Liljeström, Västfjäll, et al., 2008; Konečni, et al., 2007; North & Hargreaves, 2007; Sloboda, et al., 2001).

CHAPTER II

METHOD

Participants

Eighty-nine people from the UNCG subject pool volunteered to participate in this study, which provided a total of 5,056 survey opportunities (89 people X 8 surveys a day X 8 days of surveys). In concordance with most UNCG subject pool studies, this sample of college students was about 63% female, 58% Caucasian, and 25% African American, with a mean age 19.3 years old. Data collection took place during the fall and spring semesters. People received credit towards an optional research participation project for participating, and in addition, people who completed at least 70% of the palm pilot questionnaires were entered into a raffle for a $100 Amazon.com gift card.

Materials

Demographics. For basic demographic information, participants indicated their age, gender, ethnicity, college majors and minors, and the number of semesters they have been in college. In addition, people were asked to list their native language to highlight potential problems with comprehension. All materials were presented in English, so those cases where participants clearly had difficulty comprehending the questions and instructions were excluded from analyses.

Personality. Personality was assessed with the NEO-PI-R (Costa & McCrae, 1992). This 240-item questionnaire presents people with a variety of personality statements like "I have a very active imagination" and "I'm an even-tempered person." Participants then indicate whether or not they agree with the statement using a five point Likert scale anchored at 1 (*strongly disagree*) and 5 (*strongly agree*). Several studies have demonstrated the validity and reliability of the NEO-PI-R (Costa & McCrae, 1988; Costa, McCrae, & Dye, 1991; Jang, McCrae, Angleitner, Riemann, & Livesley, 1998; Kurtz & Parrish, 2001; McCrae & Costa, 1992), and as such, the NEO has become the gold standard of personality assessment in the field of personality and individual differences.

This scale is based on the Five Factor Model of personality (McCrae & John, 1992), and thus evaluates people in each of five domains that are comprised of six facets. Neuroticism assesses a tendency towards negative affect and includes the facets anxiety, angry hostility, depression, self-consciousness, impulsiveness, and vulnerability. Extraversion assesses a tendency towards positive affect, gregariousness, and sensation seeking, and is divided into warmth, gregariousness, assertiveness, activity, excitement seeking, and positive emotion facets. Openness to Experience assesses curiosity, aesthetic appreciation, emotional sensitivity, and novelty seeking, and is comprised of fantasy, aesthetics, feelings, actions, ideas, and values facets. Trust, straightforwardness, altruism, compliance, modesty, and tender mindedness facets represent Agreeableness, which assesses a tendency towards cooperation, compassion, and empathy. Lastly, Conscientiousness assesses people's self-discipline and need for achievement, and contains the facets competence, order, dutifulness, achievement striving, self-discipline, and deliberation.

Music background. To better understand how people's prior experience with and engagement in music influence how often they experience aesthetic chills in response to music, we gave participants the Music Background questionnaire developed by Nusbaum and Silvia (2011; Appendix A). This questionnaire inquires about the number of instruments they play, the number of hours they listen to music per day, whether they primarily listen to the lyrics or the instrumentation, how frequently they attend concerts, how important music is to them in general, and the name of their favorite band. Data collected by Nusbaum and Silvia (2011) indicated that this questionnaire provides useful information about people's music backgrounds.

Music preferences. Because earlier studies reported that certain musical structures tend to elicit chills (Grewe, Kopiez, & Altenmüller, 2009; Sloboda, 1991), participants completed the revised Short Test of Music Preferences (STOMP-R; Rentfrow & Gosling, 2003) to assess how people's favorite music genres relate to the frequency with which chills occur in response to music. Genres are rated on a 7-point Likert scale anchored at 1 (*dislike strongly*) and 7 (*like strongly*) and then grouped into four categories: Reflective and Complex (bluegrass, blues, classical, folk, international/foreign, jazz, new age, opera), Intense and Rebellious (alternative, heavy metal, punk, rock), Upbeat and Conventional (country, gospel, oldies, pop, religious, soundtracks/theme songs), and Energetic and Rhythmic (dance/electronica, funk, rap/hip-hop, reggae, soul/R&B).

The test-retest reliability of the STOMP was evaluated over a 3-week time span and found to be reliable, with correlations between earlier and later ratings of the four categories ranging from $r = .77$ to $r = .89$ (Rentfrow & Gosling, 2003). The authors assessed the generalizability of the STOMP using confirmatory factor analysis and found that data from a sample of people in all 50 states fit the four-category model well.

Unusual aesthetic experiences. Participants rated how often they experience unusual aesthetic states like chills, absorption, and awe when listening to music on the Unusual Aesthetic States questionnaire (Silvia & Nusbaum, 2011). This 10-item questionnaire assess people's tendency to experience unusual aesthetic emotions by presenting people with statements like "when listening to music, how often do you completely lose track of time," which are rated on a 7 point Likert scale with anchors 1 (*never or rarely*) and 7 (*nearly always*). Data from Nusbaum and Silvia (2011) and Silvia and Nusbaum (2011) demonstrate that it's a valid indicator of the frequency with which people experience unusual aesthetic states.

Conventionality/unconventionality. People completed the Conventionality/Unconventionality scale from Tellegen, Grove, and Waller's (1991) Inventory of Personal Characteristics. This 24-item scale presents people with descriptions like "thought of as old-fashioned by some people" or "have some rather wild ideas" and asks them to indicate how well each statement describes themselves on a 4-point scale with anchors 1 (*definitely true*) and 4 (*definitely false*). This scale is meant to capture more deviant expressions of openness to experience that are not assessed by the NEO-PI-R openness scale.

Dissociative experiences. The Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986) was used to determine how often people have dissociative experiences like perceptual aberrations of time and place or alterations of memory or consciousness. People are presented a variety of dissociative experiences such as "Some people find that sometimes they are listening to someone talk and they suddenly realize that they did not hear part or all of what was said" and asked to indicate what percentage of the time they have that experience on a 11-point scale with endpoints 0% and 100%.

This 28-item scale consists of three subscales of dissociative experiences: amnesic dissociation (loss of time and memories of life events), absorption/derealization (getting lost in a task or perceiving other people or objects as unreal), and depersonalization (the feeling of being unreal or outside oneself). Of particular interest to this study is the absorption subscale, which Kwapil et al. (2002) found to be significantly correlated with the Fantasy and Aesthetics facets of Openness to Experience ($r = .23$ and .14, respectively). Because people who experience the most chills also tend to score highly in Openness to Experience, the DES could potentially add predictive power to the experience of unusual aesthetic states like chills. Bernstein and Putnam (1986; Bernstein, Carlson, & Putnam, 1993) tested the reliability of the DES and found that test-retest scores were sufficiently correlated to suggest reliable measurement ($r = .84$, $p < .001$). This same study used Spearman rank-order correlations to determine the construct validity of the scale and found a range of .50 to .79 amongst covariates like schizophrenic, post-traumatic stress disordered, and multiple personality diagnoses, with all correlations significant at $p < .0001$.

Procedures

Initial assessment. People attended a one-hour information session, during which they completed a series of questionnaires and received instructions for the ESM assessment. All surveys were presented using MediaLab version 2010.

ESM data collection. Experience sampling data were collected on palm pilot personal digital assistants (PDA) using ESP software (Barrett & Barrett, 2001). The two-minute palm pilot questionnaire asks people about their daily life experiences including questions about mood, current environment, social interactions, music experiences, and unusual aesthetic states, which are branched appropriately depending on how people answer the questions. Mood questions include statements like "I feel happy right now" that are rated on a 7-point Likert scale with anchors at 1 (*not at all*) and 7 (*very much*). Environment questions ask about location — e.g., "right now I'm at home" (*yes* or *no*) — and temperature (i.e., "what's the temperature like?") rated on a 7-point scale with endpoints 1 (*too cold*) and 7 (*too hot*). Social interaction questions ask people if they are alone (*yes* or *no*), if they are interacting with a number of other people (*0, 1-2, 3-5, 6 or more*), and whether they feel close to those people (7-point Likert scale with 1 = *not at all* and 7 = *very much*).

Music experience questions ascertain whether people are listening to music at the time of the survey signal. If people indicate that they are listening to music, their survey is branched to a set of more detailed questions about the music and the listening environment. For example, music listeners are asked to answer (on a 7-point Likert scale with the anchors 1 = *not at all* and 7 = *very much*) questions like "I chose this music," "This music has special meaning to me," and "Overall, I like the music." In addition, music listeners are asked about characteristics of the music like whether it's on in the background, whether they're paying attention to it, and where it falls on the spectrum of simple-complex, positive-negative, calm-exciting, and familiar-unfamiliar. For the full list of survey items, see Appendix B.

For seven days, people were signaled by the palm pilot to fill out 8 surveys (randomized in 90 minute periods) from 12 pm to 12 am and had 3 minutes to answer the survey. If people didn't begin the survey within 3 minutes, the palm pilot returned to an inactive sleep mode, which locked out any activity until the next scheduled signal. Thus, if a survey wasn't answered within 3 minutes of the signal, that survey could not be returned to, and was entered as missing data. During the initial one-hour information session, ESM procedures were explained and participants filled out a practice survey. During their week of participation, people returned to the lab on day 3 to download ESM data from the palm pilot — thereby preventing data loss — and fix any equipment malfunctions.

Although event-triggered sampling (in which people fill out surveys whenever a target event — in this case, chills — occurs) was considered for this study, it had two drawbacks. First, the desire for ecological validity outweighs the possibility of creating an artificially high rate of chills that occur in response to music. The proposed study has an artful deception in that we want to know about types of music and music listening circumstances that elicit aesthetic chills, but we don't want to encourage people to change those daily routines in which chills occur. Second, earlier research demonstrates that some people never experience chills while listening to music; if this study used event-triggered sampling, we would have no within-person data for people who never get chills during the experiment. Therefore, traditional “random interval” ESM procedures are better suited for explaining the variations that occur while listening to music, since they can compare music listening experiences where chills do occur to those experiences when chills do not occur.

CHAPTER III

RESULTS

The results of this study were analyzed using multilevel modeling. In concordance with Enders and Tofighi (2007), all within-person predictors (e.g., responses to the ESM surveys) were group-mean (person) centered to avoid confounding with level 2 variability, and level 2 predictors (e.g., initial assessment battery) were grand-mean centered. 89 college students enrolled in an introductory psychology class participated in this study. However, several participants' data was excluded due to non-compliance with the ESM surveys (completing less than 25% of the surveys), obvious response patterns in level 2 data (i.e., entering the same response for every NEO item), or palm pilot failures. Thus, the final sample size was 71 people. The mean age of the remaining sample was 19 years old (SD = 1.64). The sample was composed of primarily Caucasian (53%) and African-American (24%) females (64%). On average, people answered 65% of the total number of palm pilot surveys given throughout the week of participation. Of those surveys that people completed, 23% of the time people were listening to music. Across all participants, about 10% of the time that people were listening to music, they also had chills. The intraclass correlation for chills was relatively small (ICC = 0.115), suggesting that most of the variance in this sample is within-person.

Analysis Strategy

Broadly, the goal of this study was to explore factors that are related to experiencing aesthetic chills while listening to music. We examined the influences of personality and environment factors on a person's likelihood of experiencing chills while listening to music, and more specifically, we try to explain why some people never get chills, while other people get them often. To address these questions, we used three different classes of models. Our within-person models predict chills (yes or no) as a binary outcome; thus, the level 1 models are logistic regressions and changes can be interpreted as logit differences. The between-person models — although still predicting chills — estimate a random continuous intercept for each person, and thus the coefficients are interpreted as traditional slopes.

First, we tested for within-person main effects. In this model, aspects of the music that people are listening to and the situations in which they are listening were predictors of whether or not a person had chills. Next, we looked for between-person main effects. Because earlier studies by Nusbaum and Silvia (2011; Silvia & Nusbaum, 2011) have found that openness to experience is a strong predictor of getting chills while listening to music, the between-person models focused on aspects of openness (such as feelings, aesthetics, absorption, and dissociation) as predictors of chills. Lastly, models of interactions between level 1 and level 2 variables predicted occurrences of chills while listening to music. These models focused on interactions between openness to experience, neuroticism, and other level 1 variables that seemed to be important predictors of chills in within-person models. By using this three step approach, we first identified which between and within-person variables are important contributors to the chills experience, and then explored how these factors interact to increase the likelihood that a person will experience chills while listening to music.

Because there are so few studies examining predictors of aesthetic chills — and even fewer using an experience sampling method that considers many different aspects of everyday music listening to do so — the present analysis is exploratory in nature, and thus investigates several different models. All the within-person models have a binary outcome of either chills or no chills, so the models are logistic regressions, and thus the estimated beta coefficients must be interpreted as changes in the log of the odds, or logit differences. As mentioned above, the between-person models estimate beta coefficients that may be interpreted as regular slopes. Note, however, that all coefficients reported here are raw and unstandardized.

Within-Person Models

Broadly, within-person predictors of chills were separated into two branches of models: the first branch models characteristics of music that may predict whether a person gets chills, while the second branch models situational aspects of instances of music-listening that may predict getting chills. We began by regressing chills on several characteristics of music. In this model, only music having special meaning and music being more instrumental (rather than lyrical) were significant predictors of chills ($\beta = 0.344$, $p = 0.011$ and $\beta = -1.489$, $p = 0.001$, respectively). All the other predictors in this model — namely, volume, emotional valence, and familiarity with the music — were non-significant, with p-values ranging from 0.348 to 0.919.

Our next branch of models regressed chills onto situational aspects that may influence whether or not a person gets chills while listening to music. In this model, none of the predictors — being alone, being at home, doing something creative, daydreaming, studying, watching television, exercising, being absorbed in something, and paying close attention to the music — were significant, with p-values ranging from 0.161 to 0.922. A final model regressed chills on people's emotional states while listening to music. Similar to the previous model, none of the predictors in this model — feeling happy, sad, anxious, bored, or energetic — reached significance (ps from 0.190 to 0.999).

Between-Person Models

We began between-person analyses by modeling the effect of personality on aesthetic chills. The first model we tested regressed chills on all of the global personality traits. We suspected that conscientiousness, agreeableness, and extraversion would likely be non-significant predictors of chills, and indeed, that is what we found (all ps $> .05$). In addition, openness to experience and neuroticism were also non-significant predictors ($p = 0.219$ and $p = 0.389$, respectively). Moving forward, we removed conscientiousness, agreeableness, and extraversion from the model due to non-significance, and kept openness to experience and neuroticism as predictors. However, this model found that both predictors moved further away from significance ($p = 0.221$ and $p = 0.658$, respectively).

Our second strategy for modeling the effects of personality on chills focused on modeling the facets, rather than the global personality traits. Likely, the global traits are non-significant predictors because of conflicting facets that are likely unrelated to the experience of aesthetic chills (for example, the liberalism facet of openness to experience). Our third model regresses chills onto all of the facets of neuroticism and openness to experience. Facets of the other personality factors were excluded due to non-significance in our first model, and also because they are likely irrelevant predictors of experiencing chills while listening to music.

In this model, we begin to identify some significant predictors of chills: the feelings facet of openness ($\beta = 1.168$, $p = 0.014$), and the self-consciousness ($\beta = -2.036$, $p = 0.018$), impulsiveness ($\beta = 1.695$, $p = 0.04$), and vulnerability ($\beta = 1.804$, $p = 0.027$) facets of neuroticism all had significant effects. Although the values facet of openness was approaching significance ($\beta = 0.780$, $p = 0.103$), no other predictors in this model were significant. Although this lack of significance could be attributed to issues with multicollinearity among the facets, the degree of non-significance (*p*s ranging from 0.348 to 0.914) suggests that these facets are simply not relevant in predicting whether or not a person will experience chills while listening to music.

To better understand why certain traits of openness to experience and neuroticism predict whether a person gets chills while listening to music, we tested several models that explore characteristics of schizotypal or extremely high openness personality traits that may predict aesthetic chills. Our first model regressed chills on conventionality, dissociation, and the frequency with which people experience unusual aesthetic states (divided into three separate predictors: feeling chills, feeling absorbed, and feeling touched). In this model, conventionality and frequency of feeling touched were not significant predictors of chills ($\beta = 0.055$, $p = 0.915$ and $\beta = -0.364$, $p = 0.134$, respectively). Not surprisingly, people's self-reported frequency of experiencing chills was significant (β = 0.519, $p = 0.004$), but the remaining predictors — dissociation and frequency of feeling absorbed — were only marginally significant (β = -0.30, $p = 0.084$ and β = 0.437, $p = 0.101$).

Our next model continued by eliminating the non-significant predictors and regressing chills on dissociation, frequency of experiencing chills, and frequency of feeling absorbed. In this model, frequency of experiencing chills remained significant (β = 0.414, $p = 0.033$), dissociation became significant (β = -0.332, $p = 0.050$), and frequency of feeling absorbed remained marginally significant (β = 0.262, $p = 0.105$). It is likely that the moderate correlations between dissociation and feeling absorbed (r = .385) and experiencing chills and feeling absorbed (r = .338) are creating a degree of collinearity in the model that prevents the frequency of feeling absorbed from becoming a significant predictor. Thus, our final model of personality traits and chills regressed chills on only the frequency of feeling absorbed. As the sole predictor of chills, the frequency of feeling absorbed is significant (β = 0.301, $p = 0.043$).

Our set of models examines between-person differences in experience with music as predictors of getting chills while listening to music. When chills is regressed on number of music classes taken, hours spent practicing an instrument, hours spent listening to an iPod (or other mp3 player), and how much a person values music, two significant predictors emerge — number of music classes taken (β = 0.171, $p = 0.027$) and personal value of music (β = -0.695, $p = 0.043$). The remaining predictors in this model were non-significant, with p-values ranging from 0.434 to 0.901.

Interaction Models

Several interaction models were estimated, based on the significant results of within-person and between-person models. Although we began with a model that included all the global personality factors, we eliminated three factors — agreeableness, conscientiousness, and extraversion — due to non-significance and a lack of theoretical evidence suggesting the importance of these factors when making predictions about aesthetic chills. The major focus in this analysis involves interactions among openness, neuroticism, music experience, and situational predictors of getting chills while listening to music.

In separate models of the interactions among personality facets and situational aspects of music listening, we tested whether paying close attention to the music, doing something creative while listening to music, feeling happy, listening to headphones, daydreaming, or being absorbed in the current activity interact with personality to predict chills. In the interest of thoroughness, all models used two separate sets of predictors; the first set examines interactions among situational aspects of music listening and the facets of neuroticism and openness to experience that were significant in earlier models, while the second set examines interactions among situational aspects with global neuroticism and global openness. Results reported here include only significant or notable interactions among the first set of predictors. For the full results of all the models, see tables 1 through 4.

In our first model, chills were predicted by significant interactions between the feelings and self-consciousness facets and paying close attention to the music ($\beta = 0.768$,

$p < 0.001$ and $\beta = 0.607$, $p = 0.048$ respectively), indicating that people high in these facets experienced more chills while listening to music when they were paying close attention to it. In our second model, the interaction between the feelings facet and doing something creative while listening to music approached significance ($\beta = 0.138$, $p = 0.144$), suggesting that for people high on this facet, people get more chills when they are doing something creative while listening to music.

Listening to music on headphones significantly interacted with the self-consciousness facet of neuroticism ($\beta = -0.358$, $p = 0.012$), while the impulsiveness facet had a marginally significant interaction ($\beta = -0.273$, $p = 0.058$), and the vulnerability and feelings facets approached significance ($\beta = 0.166$, $p = 0.125$ and $\beta = 0.194$, $p = 0.133$, respectively). The negative coefficients indicate that chills occur less often when listening to headphones, while the positive coefficients indicate the opposite effect. The feelings facet of openness significantly interacted with music that has special meaning to predict chills ($\beta = 0.536$, $p < 0.001$), which suggests that when people high on the feelings facet are listening to music that has special meaning, they tend to get chills more often.

Both the feelings facet and the vulnerability facet had significant interactions with familiar (versus unfamiliar) music when predicting chills ($\beta = -0.385$, $p = 0.008$ and $\beta = -0.682$, $p = 0.014$, respectively), such that as music becomes more unfamiliar, people high in openness or neuroticism get more chills. Although it is curious that both high neuroticism and high openness people get more chills when listening to unfamiliar music, the finding has subtle implications for theories about chills which are addressed in the general discussion. None of the remaining interaction terms (feeling happy, daydreaming, and being absorbed in the current activity) were significant moderators of the feelings, self-consciousness, impulsiveness, or vulnerability effects on chills.

CHAPTER IV

DISCUSSION

Although the chills phenomenon has become a popular subject for researchers, it's still unclear why chills happen or what causes the variability between people. Most of the studies on chills have used either self-report or physiological indicators of chills in response to experimenter-selected music to learn about the experience. But because people don't typically listen to the type of music that experimenters select, and because listening to music in a lab setting is such an anomaly in people's daily lives, these studies are less representative of people's everyday experience of chills in response to music. The current study addressed this issue by using an experience sampling method to get a broader picture of what chills and music listening look like in everyday life. Exploratory models indicated what we suspected — that chills are influenced by some personality traits and contextual aspects of music listening situations, but not others — and also highlighted an unexpected, yet previously foreshadowed influence of neuroticism in predictions about chills.

Several models were tested to examine the influence of personality, music experience, music characteristics, and situational aspects of music listening in predictions about who gets aesthetic chills while listening to music, and why. This study was guided by past research that demonstrates the importance two concepts: structural characteristics of chills-inducing music and mediators of the openness to experience–chills relationship. However, these results also demonstrated some unexpected findings.

In general, we found that the facets of personality traits are more important in predictions about chills that the global traits themselves. Though it's certainly not a revolutionary finding, it does suggest that future studies about aesthetic chills should include facet-level measures of personality. A more surprising finding in the current study was the important role of neuroticism in experiencing chills. Although it was unexpected, in hindsight, the result was hinted at — but disregarded — in earlier studies. For example, Nusbaum and Silvia (2011) found that openness did have the largest effect on chills, but notably, neuroticism had the second largest effect ($\beta = 0.12$). Similarly, Silvia and Nusbaum (2011) also found that, depending on analyses, neuroticism again had the next largest effect behind openness. In the present study, three facets of neuroticism emerged as important predictors of chills: self-consciousness (shyness or social anxiety), impulsiveness, and vulnerability (a general susceptibility to stress), which suggests that earlier research focusing only on openness was misguided. To examine these findings in more context, we can look to Huron's (2006) imagination-tension-prediction-reaction-appraisal (ITPRA) theory to help understand the role that neuroticism, openness to experience, and structural characteristics of music play in these results.

Dueling Pathways

The current study provides evidence that both the positive feelings that come from correct predictions *and* the negative startle or surprise feelings that come from invalidated predictions elicit the pleasurable experience of chills in people. The key difference suggested by these results is that personality traits — specifically, openness and neuroticism — predict whether people experience chills via the positive feelings pathway or the negative feelings pathway. In Huron's (2006) proposal, people can experience chills when they are pleased that they have correctly predicted changes in the music — an experience that we would consider the openness pathway. Alternatively, people can experience chills when they are surprised by changes in the music that initially elicit a startle or fear response, but are then quickly appraised as what those changes really are — harmless, though disturbing, unexpected shifts. Because people high in trait neuroticism are often "on edge," and thus more sensitive to potentially startling stimuli — for example, large shifts in the tempo, volume, or type of instruments in music — the second pathway is what we would call the neuroticism pathway.

Indeed, the results of this study paint the characteristics of incidences of aesthetic chills as occurring via two distinct pathways, which differ according to dimensions of people's trait openness and trait neuroticism. For example, significant within-person predictors of chills — music having special meaning and music being more instrumental, rather than lyrical — could be interpreted as being a familiar, predictable, and positive experience that elicits chills from listeners who have subconsciously correctly predicted changes in the music structure. The data also show that the feelings facet of openness has a significant positive effect on whether or not people experience chills, such that people who are more in tune to their feelings and emotions experience chills more often. Furthermore, we found that interactions between feelings and situational aspects that suggest people are listening intently to the music (i.e., listening to headphones, doing something creative while listening, and paying close attention to the music) were trending towards significance. Taken together, these findings seem to suggest that when people high in openness experience chills while listening to music, they are perhaps seeking out these experiences by intently listening to special, unfamiliar, and more structurally complex (instrumental) music.

The data also support the notion of a neuroticism pathway to chills. Although global neuroticism was not significant predictor of chills, three facets emerged as significant between-person predictors of chills — namely, the self-consciousness, impulsiveness, and vulnerability facets. Furthermore, in cross-level interactions, these facets of neuroticism significantly interacted with situational predictors of chills, such as getting more chills as music becomes more unfamiliar, listening to music on headphones, and paying close attention to the music, suggesting that for those people high in certain facets of neuroticism, chills occur more often by accident as part of a startle response, opposed to purposefully seeking them out, as high openness people seem to do.

Given these results, it is possible to interpret unfamiliar music as a pivot point that separates the neuroticism and openness pathways to chills. In the results, it was noted that both interactions involved negative slopes. In other words, both traits have similar responses to unfamiliar music. However, when the other results including the traits are considered, the picture of chills that occur in response to music become very different, depending on a person's degree of openness or neuroticism. For example, when a person high in vulnerability — who is already prone to stress, anxiety, and skittishness — listens to music that is unfamiliar, they could be very easily startled by those same large changes in tempo, volume, or instruments that predicted chills in previous studies, thereby evoking an anxiety response that is quickly shifted to relief once the music that caused them to start in the first place is appraised as non-threatening, and thus is interpreted as a pleasurable experience.

Alternatively, when a person high in openness to experience listens intently to unfamiliar music, they tend to make subconscious predictions about upcoming changes in the music, according to Huron's (2006) ITPRA theory. When these changes are predicted correctly, the listener is lead to feel excited or exhilarated about feeling "in tune" with the music and interprets the resulting chills as a pleasant experience. Ultimately, both pathways lead to a positive experience (chills), but the ways there do seem to be different.

What does this mean for theories of chills? As expected, Konečni's Aesthetic Trinity theory was not supported (though not directly tested, either) — it's clear from the results of our study that chills are not limited to being a response induced by music that leads people to recall moving real-world events. If this theory was correct, we would have expected to find several results. For example, music that elicits chills would consistently be associated with a particular valence. Music with special meaning would (more often than not) be attributed to chills-inducing music, and presuming that everyone has experienced something exciting, happy, or sorrowful in their lifetime, music that embodies these themes should have recalled those real-world events — and thus elicited chills — for everyone. Furthermore, if associated memories were critical to the chills response, we would expect that almost all chills occur while listening to familiar music. Despite using a method that should make it easier to find these outcomes, none of the results expected, given that Konečni's theory could be supported, were suggested in the data.

Conversely, it seems that Huron (2006) was on to something with his expectation-based theory. Our results, however, expand on his expectation-based theory about chills that focuses on states to include important individual (trait) differences. When we combine the ITPRA theory with results from experimental work involving physiological responses to music, chill-inducing structural features of music, and individual differences that are associated with having more chills, we can make predictions about who will experience chills and when.

Strengths, Limitations, and Current Directions

The present study has two major advantages over traditional experimental work on aesthetic chills. First of all, this study is an original investigation of people's experiences of chills — although other studies have examined the phenomenon, they do so by sacrificing ecological validity (Blood & Zatorre, 2001; Grewe et al., 2007, 2009) or using extremely small sample sizes (Sloboda et al., 2001). Second, this study collected data on many aspects of personality, music preferences and habits, and situational factors that potentially influenced whether a person experiences aesthetic chills while listening to music. Using an experience sampling method allowed us to peek into everyday experiences involving music listening and chills, so that we may identify important factors that contribute to experiences of chills.

Some of the remaining questions that the current study raised post-hoc (but was unable to address directly) involve the subjective experience of chills and the role that a person's general tendency toward affective intensity may play in the frequency of experiencing chills. For example, are all experiences of aesthetic chills equally as arousing, or are there some experiences that are more intense than others? Studies have found that some people generally experience emotions more intensely than other people (Jones, Leen-Feldner, Olatunji, Reardon, & Hawks, 2009; Larsen & Diener, 1987); is it possible that these differences carry over to aesthetic emotion? If so, which situational aspects influence the intensity of the chills experience, and is there some degree of affective intensity which precludes people who feel emotions less intensely from feeling these "super chills?"

Although this sample was small for studying individual differences in a multilevel modeling approach, we were still able to find several important factors that significantly predict getting chills while listening to music. With a larger sample and better compliance on the within-person surveys, we would expect higher base-rates of chills experienced during sampling and greater variance within the sample itself, thus lending more power to the analyses and a better chance of finding significant results in those models where predictors approached or tended toward significance. To address these issues, an ongoing study employs a new method of experience sampling that uses phone-based surveys that include fewer questions, prompt people with more surveys throughout the day, and record data in real-time without needing to meet with the experimenter midweek (Burgin, Silvia, Eddington, & Kwapil, in press). This new method can accommodate a much larger sample and should improve sample variability because it’s not limited by equipment availability or failures (as almost everyone carries a cell phone with them at all times), time-consuming lab visits for data download, or subject to missing data when participants forget (or find it too cumbersome) to carry around the extraneous survey equipment. They may be hot right now, but perhaps with this study, aesthetic chills will catch on fire.

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APPENDIX A

TABLES

Table 1: Within-Person Models

Variable	β (Unst)	Std Error	β/S. E.	2-Tailed P-Value
Music Characteristics				
VOLUME	0.035	0.133	0.264	0.792
EXCITING	0.091	0.110	0.833	0.405
NEGATIVE	-0.117	0.125	-0.938	0.348
COMPLEX	0.047	0.130	0.362	0.717
SPECIAL MEANING	0.344	0.136	2.531	0.011
UNFAMILIAR	0.012	0.119	0.101	0.919
LYRICS	-1.489	0.467	-3.190	0.001
Situational Aspects				
ALONE	0.472	0.465	1.013	0.311
HOME	-0.050	0.507	-0.098	0.922
CREATIVE	0.066	0.127	0.517	0.605
DAYDREAMING	0.135	0.115	1.181	0.238
STUDYING	0.098	0.133	0.734	0.463
WATCHING TV	0.039	0.108	0.364	0.716
EXERCISIING	0.095	0.150	0.633	0.527
ABSORED	0.137	0.109	1.264	0.206
PAYING ATTENTION	0.205	0.146	1.400	0.161
Emotions				
FEEL HAPPY	0.176	0.147	1.203	0.229
FEEL SAD	0.160	0.129	1.240	0.215
FEEL ANXIOUS	0.081	0.130	0.623	0.533

Table 2: Between-Person Models

Variable	β (Unst)	Std Error	β/S. E.	2-Tailed P-Value
Global Personality Traits				
1.OPENNESS	0.772	0.628	1.230	0.219
CONSCIENTIOUS	-0.491	0.760	-0.646	0.518
EXTRAVERSION	-0.249	0.653	-0.381	0.703
AGREEABLENESS	0.057	0.663	0.086	0.932
NEUROTICISM	-0.565	0.657	-0.861	0.389
2.OPENNESS	0.685	0.560	1.223	0.221
NEUROTICISM	-0.294	0.662	-0.443	0.658
Facets of N and O				
FANTASY	-0.038	0.353	-0.108	0.914
AESTHETICS	-0.194	0.306	-0.633	0.527
FEELINGS	1.168	0.478	2.445	0.014
ACTIONS	-0.609	0.704	-0.866	0.386
IDEAS	-0.486	0.569	-0.854	0.393
VALUES	0.780	0.478	1.632	0.103
ANXIETY	-0.564	0.600	-0.939	0.348
ANGRY HOSTILI	-0.176	0.534	-0.329	0.742
DEPRESSION	-0.133	0.353	-0.377	0.706
SELF-CONSCIOUS	-2.036	0.862	-2.361	0.018
IMPULSIVENESS	1.695	0.827	2.049	0.040
VULNERABILITY	1.804	0.817	2.209	0.027
High Openness				
1.CONVENTIONALITY	0.055	0.516	0.107	0.915
DISSOCIATION	-0.300	0.173	-1.731	0.084
FREQU CHILL	0.519	0.181	2.869	0.004
FREQU TOUCH	-0.364	0.243	-1.499	0.134
FREQU ABSORB	0.437	0.267	1.640	0.101
2.DISSOCIATION	-0.332	0.169	-1.964	0.050
FREQU CHILL	0.414	0.195	2.130	0.033
FREQU ABSORB	0.262	0.162	1.621	0.105
3.FREQU ABSORB	0.301	0.149	2.027	0.043
Music Experience				
# HOURS ON IPOD	-0.198	0.253	-0.783	0.434
# HOURS PRACTICE	0.012	0.099	0.124	0.901
# MUSIC CLASSES	0.171	0.077	2.218	0.027
VALUE OF MUSIC	-0.695	0.343	-2.024	0.043

Table 3: Cross-Level Interaction Models, Facet

Variable	β (Unst)	Std Error	β/S. E.	2-Tailed P-Value
<u>Slope Chills on Absorbed</u>				
FEELINGS	0.113	0.095	1.197	0.231
SELF-CONSCIOUS	0.155	0.151	1.029	0.303
IMPULSIVENESS	-0.187	0.146	-1.285	0.199
VULNERABILITY	0.079	0.168	0.473	0.636
<u>Slope Chills on Alone</u>				
FEELINGS	0.144	0.352	0.408	0.684
SELF-CONSCIOUS	-0.872	0.627	-1.390	0.164
IMPULSIVENESS	-0.276	0.499	-0.554	0.579
VULNERABILITY	0.948	0.754	1.258	0.208
<u>Slope Chills on Attention</u>				
FEELINGS	0.768	0.198	3.873	0.000
SELF-CONSCIOUS	0.607	0.307	1.977	0.048
IMPULSIVENESS	-0.217	0.283	-0.767	0.443
VULNERABILITY	-0.288	0.317	-0.908	0.364
<u>Slope Chills on Creative</u>				
FEELINGS	0.138	0.095	1.459	0.144
SELF-CONSCIOUS	-0.026	0.155	-0.165	0.869
IMPULSIVENESS	0.018	0.153	0.120	0.905
VULNERABILITY	0.119	0.164	0.726	0.468
<u>Slope Chills on Daydreaming</u>				
FEELINGS	0.096	0.130	0.742	0.458
SELF-CONSCIOUS	-0.169	0.153	-1.105	0.269
IMPULSIVENESS	-0.167	0.180	-0.925	0.355
VULNERABILITY	0.118	0.166	0.711	0.477
<u>Slope Chills on Happy</u>				
FEELINGS	0.129	0.122	1.060	0.289
SELF-CONSCIOUS	0.084	0.146	0.578	0.563
IMPULSIVENESS	0.136	0.193	0.709	0.478
VULNERABILITY	-0.105	0.154	-0.681	0.496
<u>Slope Chills on Headphones</u>				
FEELINGS	0.166	0.108	1.534	0.125
SELF-CONSCIOUS	-0.358	0.142	-2.519	0.012
IMPULSIVENESS	-0.273	0.144	-1.899	0.058
VULNERABILITY	0.194	0.129	1.501	0.133

Table 4: Cross-Level Interaction Models, Global

Variable	β (Unst)	Std Error	β/S. E.	2-Tailed P-Value
Slope Chills on Absorbed				
OPENNESS	0.281	0.148	1.903	0.057
NEUROTICISM	0.218	0.164	1.326	0.185
Slope Chills on Alone				
OPENNESS	−0.568	0.551	−1.031	0.303
NEUROTICISM	−0.182	0.559	−0.325	0.745
Slope Chills on Attention				
OPENNESS	0.836	0.328	2.553	0.011
NEUROTICISM	0.191	0.321	0.594	0.552
Slope Chills on Creative				
OPENNESS	0.452	0.151	3.005	0.003
NEUROTICISM	0.252	0.125	2.012	0.044
Slope Chills on Daydreaming				
OPENNESS	−0.023	0.161	−0.144	0.885
NEUROTICISM	−0.208	0.148	−1.406	0.160
Slope Chills on Happy				
OPENNESS	0.281	0.148	1.903	0.057
NEUROTICISM	0.218	0.164	1.326	0.185
Slope Chills on Headphones				
OPENNESS	0.307	0.168	1.832	0.067
NEUROTICISM	−0.041	0.156	−0.263	0.793

APPENDIX B

MUSIC BACKGROUND QUESTIONNAIRE

Do you play a musical instrument proficiently? NO YES

If *YES*, which instrument(s)? ____

How many hours per week do you spend practicing or performing? __________ hours

How many college classes related to music have you taken, if any? _________ classes

Overall, how important is music to you?

1 2 3 4 5

Not at all important *Extremely Important*

How often do you attend concerts or other live performances of music? *(Circle one)*

Almost never *One or two a year* *One or two a month* *At least one a week*

Do you own a portable music player, like an iPod, an iPhone, or a similar MP3 player? NO YES

If *YES*, how many hours per day do you listen to music on it? _______________ hours

Overall, about how many hours per day do you spend listening to music? _____________ hours

When you listen to music, is the music mostly on in the background or are you listening to it closely? *(Circle one)*

Mostly just in the background *About equal* *Mostly listening to it closely*

When you listen to music with lyrics, are you mostly listening to the lyrics/singing or are you mostly listening to the music/instrumentation? *(Circle one)*

Mostly the lyrics *About equal* *Mostly the music*

What would you say is your all-time favorite band/performer? _____________________

What would you say is your all-time favorite song or album?_______________________

What radio stations, if any, do you listen to the most? _________________________

APPENDIX C

ESM PROTOCOL

Always Ask
1|I hear music right now|no %next 36|yes %next 21

2|Right now I have chills, shivers, or goose bumps|no|yes

3|Right now I'm alone|no %next 5|yes %next 4

4|Right now I would rather be with other people|no|yes

5|I am interacting with (choose one): %TYPE list|0 people %next 7|1-2 people %next 6|3-5 people %next 6|6 or more people %next 6

6|I feel close to this person (these people) %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

7|Right now I'm at home|no|yes

8|I feel happy right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

9|I feel energetic right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

10|I feel bored right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

11|I feel sad right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

12|I feel anxious right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

13|I am doing something creative right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

14|I am daydreaming right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

15|I am studying right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

16|I am watching television right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

17|I am exercising right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

18|I am wrapped up in what I'm doing right now %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

19|What's the temperature like? %TYPE list|1 (too hot)|2|3|4|5|6|7 (too cold)

20|I am listening to headphones right now %next 40 %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

If there is music

21|Is the music in the background? %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

22|Overall, I like the music %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

23|How loud is the music? %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

24|I feel energetic right now %TYPE list|1 (too quiet)|2|3|4 (just right)|5|6|7 (too loud)

25|I would describe this music as %TYPE list|1 (simple)|2|3|4|5|6|7 (complex)

26|I would describe this music as %TYPE list|1 (positive)|2|3|4|5|6|7 (negative)

27|I would describe this music as %TYPE list|1 (calm)|2|3|4|5|6|7 (exciting)

28|I would describe this music as %TYPE list|1 (familiar)|2|3|4|5|6|7 (unfamiliar)

29|I am paying attention to the music %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

30|Right now I would rather not hear music %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

31|This music has special meaning to me %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

32|I chose this music %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

33|What kind of music is it? (pick ONE)|Jazz|Pop/Top 40|Hip hop/Rap|Rock|Classical|Country/Folk/Bluegrass|Electronic

34|Does the music have words?|no|yes

35|Right now I'm attending live music %next 2 %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

If there's no music

36|Right now I'd like to listen to music|no %next 38|yes %next 37

37|If yes, what kind? (pick ONE)|Jazz|Pop/Top 40|Hip hop/Rap|Rock|Classical|Country/Folk/Bluegrass|Electronic

38|There is music in my head %TYPE list|1 (not at all) %next 2|2|3|4|5|6|7 (very much)

39|I like the music in my head %next 2 %TYPE list|1 (not at all)|2|3|4|5|6|7 (very much)

40|Goodbye!