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Listening Between the Notes: Aesthetic Chills in Everyday Music Listening

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Who gets chills—a pleasurable feeling of goose bumps—in response to music, and why? The current study used experience sampling to examine within-person variability in aesthetic chills. For one week, 106 undergraduate participants responded to 10 daily surveys, delivered via their cell phones, about their momentary activities, emotions, and environment, with an emphasis on whether they were listening to music and were experiencing chills. At the within-person level, music listening context and emotional states during music listening influenced whether or not people got chills. Chills were more likely when people listened to music that they chose and that they were listening to closely. Chills were also more likely when people were listening to music while happy or while sad, but not while worried. Overall, the study illustrates how music listening context and other within-person differences contribute to aesthetic chills in people's everyday environments.

Keywords: aesthetic chills, personality, openness to experience, music, experience sampling

In research on music and aesthetic emotions, chills are "hot." Within the last decade, psychologists have studied the chill effect—goose bumps, a sensation of hair standing on end, or shivers down the spine—that people get in response to music. Researchers have examined from many different perspectives how chills are affected by lyrics versus melodies (Ali & Peynircioglu, 2006), emotional and aesthetic priming (Konečni, Wanic, & Brown, 2007), meaningfulness of music (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, little is known about people's everyday music listening habits and experience of aesthetic chills.

Recent research often has taken one of two approaches to examining the chills response to music: one explores characteristics of music that evoke chills in listeners, while the other explores individual differences in the experience of chills. Several researchers have reported that chills are associated with physiological indicators of emotional arousal—for example, increased skin conductance, heart rate variability, and respiratory depth (Benedek & Kaernbach, 2011; Craig, 2005; Guhn, Hamm, & Zentner, 2007; Nagel et al., 2008)—and that the experience is accompanied by increased blood flow to pleasure centers in the brain and the release of euphoria-inducing neurotransmitters (Blood & Zatorre, 2001; Goldstein, 1980). Other researchers indicated that certain music structures—such as large shifts in tempo or volume, or unexpected vocal or instrument introductions—are often present at the time people report feeling chills (Gabrielsson, 2006; Grewe et al., 2009; Grewe et al., 2007; Huron, 2006; Huron & Margulis, 2010).

Other studies suggest that there is wide variability in how often people experience chills while listening to music. In a sample of college students, most people reported having aesthetic chills occasionally, some people reported they nearly always experience chills, and about 8% of the sample reported never experiencing chills (Silvia & Nusbaum, 2011). Similarly, Sloboda (1991) found that while listening to music in the previous five years, 90% of his sample reported feeling shivers down the spine and 62% reported getting goose bumps. Recent work also suggests that individual differences in personality account for much of this variability. For example, Nusbaum and Silvia (2011; Silvia & Nusbaum, 2011)

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found that openness to experience was the strongest predictor of chills when compared to other personality domains, gender, expertise in the arts, and fluid intelligence. Further individual differences—such as rating music as more important, playing an instrument, and listening to music for more hours during the day—were found to partially mediate the effect of openness on chills, but the indirect effects were small and failed to account for considerable variance (Nusbaum & Silvia, 2011).

Despite the strengths of this research, there remains a lack of understanding about why music gives us chills. Given the robust effects of music characteristics on chills and the physiological responses involved with chills, exploring within-person differences (such as listening context, mood of the listener, emotional valence of the music, and other music characteristics such as tempo, volume, or genre) in the experience of music-elicited chills seems like a logical extension of this work. Most studies regarding chills, however, are situated in laboratory environments and assess between-person differences in music listening habits, personality, and physiological or self-reported emotional responses to experimenter-chosen music. To examine the potentially fertile area of within-person differences in the experience of aesthetic chills, researchers should consider the usefulness of a somewhat different methodology.

Although it is relatively uncommon in the field of aesthetics, experience sampling is particularly useful for studying the chills that people experience in response to music. Advocated by Csikszentmihalyi and Lefevre (1989) as a useful method for researching everyday experiences, the Experience Sampling Method (ESM) captures behaviors, thoughts, and feelings that occur throughout the day (Bolger & Laurenceau, 2013; Conner, Tennen, Fleeson, & Barrett, 2009). For an extended period of time (usually a week or two), people are surveyed multiple times per day to assess the variation that occurs within their everyday lives. Unlike traditional methodologies used to study chills, this method allows researchers to explore the wide variability of situational factors related to getting chills, including the idiosyncrasies of everyday situations that may be lost to typical survey methods assessing the chills experience.

Two small studies suggest that experience sampling is a fruitful way to study music experiences in everyday life. Sloboda, O'Neill, and Ivaldi (2001) found that although people listen to music frequently (about 44% of the time), the music is often in the background of some other activity. Juslin, Liljeström, Västfjäll, Barradas, & Silva (2008) had similar findings: about 37% of the time, people were listening to music, and in 64% of the music listening episodes, people said that the music influenced their emotional states, leading the authors to conclude that situational differences ought to be included when trying to estimate how often people experience emotions when listening to music.

Although we know some about who gets chills (Nusbaum & Silvia, 2011), the type of music that elicits chills (Gabrielsson, 2006; Grewe et al., 2009; Grewe et al., 2007; Huron, 2006; Huron & Margulis, 2010), and what happens physiologically when we get chills (Benedek & Kaernbach, 2011; Blood & Zatorre, 2001; Craig, 2005; Goldstein, 1980; Guhn et al., 2007; Nagel et al., 2008), we know little about when and why chills occur outside the lab in people's natural environments. Thus, the present study explored the context in which chills occur when listening to music by examining within-person differences in chills during everyday music listening experiences. Using ESM allowed us to examine the environmental, emotional, and circumstantial factors associated with having chills in response to music. Furthermore, because research shows that there is extreme variability in how people engage and interact with music (Hargreaves & North, 1999; Juslin et al., 2008; Konečni et al., 2007; North & Hargreaves, 2007; Sloboda et al., 2001), we expected that various situational factors would influence people's chills response to music.

Since the goal of this work is to describe within-person differences in everyday music listening and aesthetic chills, we focused on factors that could be important to whether or not music evoked chills during a typical day. First, we examined contextual aspects of the music. Does choosing what music to listen to influence whether people get chills? Is it only special music that gives us chills? Or, perhaps, is getting chills simply a matter of paying close attention to the music? Earlier work has touched on similar questions (Gabrielsson, 2006; Grewe et al., 2009; Huron & Margulis, 2010; Sloboda et al., 2001), yet none has examined these potential avenues for chills in the context of everyday music listening. Second, we examined the influence of emotional states on getting chills while listening to music. As ubiquitous as music is in people's everyday lives, it is likely that people experience a range of emotions when listening to music. Although Juslin et al. (2008) found that music can alter emotional states, we have yet to explore whether different emotions experienced while listening to music are associated with getting chills. The present study examines these questions in the context of everyday music listening.

Method

Participants

A total of 106 students enrolled at the University of North Carolina at Greensboro participated in this study. The data were collected as part of a larger study exploring individual differences in personality, cognitive abilities, and music listening habits and preferences. As is typical of the university demographics, our sample was predominately female (73%). The mean age of participants was 19.6 years old ($SD = 2.6$ years). This sample has a unique advantage in the study of music listening habits: Although about 81% of our participants were enrolled in psychology classes at the university and volunteered as part of an optional research credit, the remaining 19% of our sample was recruited from the university's School of Music, Theater, and Dance. These participants were eligible if they were currently enrolled as a graduate or undergraduate student in a major related to music, such as music performance, theory, or education, and they were compensated $20 in cash for participating.

Procedure

Before initiating ESM data collection, all participants attended a 1-hr information session during which they received instructions for the ESM assessment. ESM data were collected using SmartQ Interactive Voice Response (IVR) software (Telesage, 2009). This software offers two advantages over traditional, palm pilot-based ESM procedures. First, the IVR software administers the surveys on the participants' own cell phones, and responses to survey questions are given using the standard 0 to 9 telephone keypad (for a more detailed review, see Burgin, Silvia, Eddington, & Kwapil, 2013). This capability eliminates the need for participants to carry around an extra device—which they may forget or misplace, thus increasing missing data—during the experience sampling period. Second, the IVR software can be programmed to administer surveys randomly during any 12-hr block of time, such as 8:00 a.m. to 8:00 p.m. or 12:00 noon to 12:00 midnight. For college students who may operate on different circadian cycles and daily schedules, this capability allows participants to choose any 12-hr survey window in which they are most likely to be awake, thereby minimizing missing data from surveys initiated when participants are asleep (see Silvia, Kwapil, Eddington, & Brown, in press).

Experience sampling assessment began immediately following the information session. For seven days, the IVR system called people's cell phones to administer surveys 10 times a day (randomized in roughly 75-min periods) during the participant-chosen 12-hr window of time. Chills are relatively uncommon, so sampling people's experience 10 times during their waking hours increases the odds of observing chills. If people missed the survey call, they were able to call the IVR system back within 5 min to complete the survey.[1]

The survey asked people about their mood, current environment, social interactions, music experiences, and experience of chills. The surveys took approximately 2 to 3 min to complete. Because there is a trade-off between how many times people can be called per day and how many items they can be asked at each call—that is, people could respond to shorter surveys more frequently or to longer surveys less frequently (Silvia, Kwapil, Walsh, & Myin-Germeys, 2013)—our survey was brief and focused. We included three blocks of survey items: The first asked whether people were listening to music ("Are you listening to music right now?") and whether people had chills ("Do you have emotional chills or goose bumps?") with response options *yes* or *no*. The second block asked about people's current mood—for example, "Right now how happy do you feel?", "Right now how sad do you feel?", and "Right now how worried do you feel?" (scale response, 1 = *not at all* to 7 = *very much*) and whether people were currently alone ("Are you alone or with other people?") with response options *alone* or *with others*. The third block of survey items was asked only if people said they were listening to music, and included the items "Did you choose this music?" (response options *yes* or *no*), "Does this music have special meaning to you?" (scale response, 1 = *not at all* to 7 = *very much*), and "Are you listening closely to the music?" (scale response 1 = *not at all* to 7 = *very much*).

Results

Data Reduction and Model Specification

Broadly, the goal of this study was to explore within-person differences that are related to experiencing aesthetic chills while listening to music. For the chills item, the low intraclass correlation coefficient of the null model (ICC = .136) supports our suspicion that most of the variance in chills (around 86%) occurs at the within-person level. Thus, we examined environmental and experiential influences on a person's likelihood of experiencing chills while listening to music. The results of this study were analyzed using logistic regression to predict a binary outcome of chills (*yes* or *no*); therefore, estimates can be interpreted as logit differences.

All within-person predictors (e.g., responses to the ESM surveys) were group-mean centered (i.e., centered at each person's mean) to avoid confounding with between-person variability (Enders & Tofighi, 2007). The models were estimated using Mplus 7, using maximum likelihood with robust standard errors. The level 1 effects were treated as random. All coefficients reported are unstandardized. Several participants' data were excluded due to very low compliance with the ESM procedure (i.e., they completed less than one survey a day). Thus, the final sample size was 98 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%).

Frequency of Chills and Music Listening

On average, people answered about 46 (*SD* = 14.6, min = 11, max = 77) surveys during the week of experience sampling. Of those surveys that people completed, 22% of the time people were listening to music. Nearly 14% of the time that people were listening to music, they also reported having chills. About 81% of our sample (79 people) reported experiencing at least one chill episode while listening to music during ESM data collection, and on average, people experienced a total of 3.73 chills. Figure 1 shows the distribution of chills, which was much wider than in past research (Nusbaum & Silvia, 2011). The wider range highlights a strength of experience sampling, which can capture events that are more likely in everyday life than in the laboratory.

Music Context and Chills

What factors made people more likely to experience chills? In our first model, we regressed chills on the group of predictors involving music context (did people choose the music, did the music have special meaning, and were people listening to music closely or in the background). People were significantly more likely to get chills when they chose the music ($b = .953$, $p < .001$) and when they were listening to music closely ($b = 0.520$, $p < .001$). Listening to music that has special meaning—though only marginally significant—was also associated with a higher likelihood of getting chills ($b = .244$, $p = .080$). Only the variance component of the chills random intercept was significant, indicating that people experience chills with varying frequency; the remaining effects did not vary significantly across people (see Table 1 for details of the variance components).

[1] 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 outweighed the possibility of creating an artificially high rate of chills that occur in response to music. We wanted to know about types of music and music listening circumstances that elicit aesthetic chills, but we didn'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 got chills. Therefore, traditional "random interval" ESM procedures are more useful because they can compare music listening experiences where chills do occur to those experiences when chills do not occur.

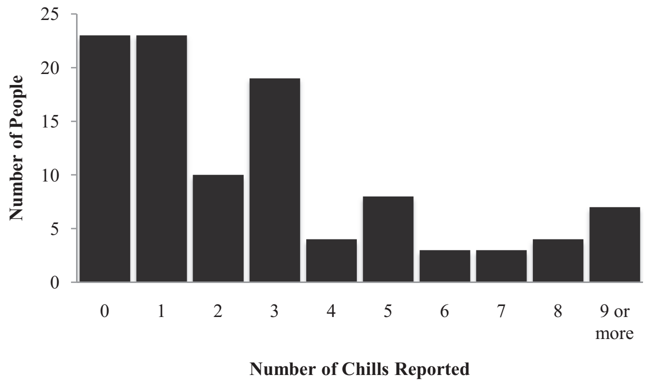

Figure 1. Frequency distribution of chills.

Does listening to music in the presence of others affect the chills response? Our next model regressed chills on being alone versus being with others; the alone variable was dummy coded (0 = *no*, 1 = *yes*). Being alone did not significantly increase the likelihood that people experienced chills while listening to music ($b = 0.042$, $p > .50$), but this effect's variance component was significant (see Table 2), indicating significant heterogeneity among people.

Emotional States and Chills

Are some emotional states more conducive to getting chills than others? To explore this, a final model regressed chills on people's emotional states while listening to music (feeling happy, feeling sad, and feeling worried). People were significantly more likely to get chills if they were listening to music when they felt happy ($b = .417$, $p = .003$) or sad ($b = .293$, $p = .007$), but not when they felt worried ($b = -0.017$, $p > .50$). In this model, the variance components of the chills intercept and the slope of *worried* were significant, again suggesting that people experience chills with varying frequency and that the effect of being worried varies across people (see Table 3 for details). Overall, emotional states that people experienced when listening to music were an important influence on whether they received chills.

Discussion

Although chills have become a popular subject for researchers, it is still unclear when chills happen and why. Most studies 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 music that experimenters select, and because listening to music in a lab setting is an anomaly in people's daily lives, these studies poorly approximate people's everyday experience of chills in response to music and reveal little about within-person differences in the experience of chills. The current study addressed this issue by using experience sampling to get a broader picture of what chills and music listening look like in everyday life. The results indicated what we suspected—that chills are influenced by some contextual aspects of music listening situations but not others.

Overall, we found that people spend a fair amount of time listening to music—people indicated that they were listening to music in about 25% of the surveys that they responded to. Chills in response to music listening also seem to occur somewhat frequently for most people: in our sample, 81% of people reported experiencing at least one chill episode while listening to music during the week of surveys. In addition, people on average experienced chills more than three times while listening to music during their week of participation. These simple descriptive statistics highlight the strengths of experience sampling methods, which are one of the only ways to estimate how often things actually happen in people's everyday lives (Conner et al., 2009; Hektner, Schmidt, & Csikszentmihalyi, 2007). According to our results, chills are both common and rare. Over the course of a week, most people will experience chills at least a few times from music, so chills are a prevalent reaction to music. But chills occurred at only 14% of the times people reported listening to music, so the overall likelihood of music sparking chills is low.

In terms of the music listening contexts associated with getting chills, we found that the context was important: Certain emotional states and other contextual factors of the music predicted whether chills were experienced in everyday life. In

Table 2
Variance Components of the Model: Being Alone on Chills While Listening to Music

	Estimates		
	Tau	p	95% CI
Chills intercept	1.769	= .001	.738, 2.80
Being alone	.011	= .051	.000, 0.023

Note. Tau = the estimate of the variance component of a given variable.

Table 1
Variance Components of the Model: Music Listening Context on Chills

	Estimates		
	Tau	p	95% CI
Chills intercept	2.945	= .007	.820, 5.070
Listening closely to music	.024	>.50	−.581, 0.630
Having chosen the music	.062	>.50	−.938, 1.062
Listening to music that has special meaning	.870	>.50	−8.775, 10.515

Note. Tau = the estimate of the variance component of a given variable.

Table 3
Variance Components of the Model: Emotion States on Chills While Listening to Music

	Estimates		
	Tau	p	95% CI
Chills intercept	2.376	= .007	.651, 4.101
Feeling happy	.141	>.50	−1.312, 1.594
Feeling sad	.026	>.50	−.376, 0.428
Feeling worried	.245	= .010	.058, 0.432

Note. Tau = the estimate of the variance component of a given variable.

particular, we found that listening to music while feeling happy or sad, but not while feeling worried, significantly increased the likelihood that chills would occur. Likewise, we also found that people who chose the music they were listening to and people who were listening to music closely were significantly more likely to experience chills. And—although the effect was only marginally significant—it also seems that people get chills more often when they are listening to music that already has some sort of special meaning to them.

These findings dovetail with earlier studies of aesthetic experiences: Getting chills when we feel happy or sad while listening to music is consistent with prior work findings that aesthetic chills elicit the same activity in the brain that is experienced during other euphoric or intensely pleasurable activities (Blood & Zatorre, 2001; Goldstein, 1980). Although in this case feeling sad might seem contradictory to the effect, earlier work (Goldstein, 2009) suggests that people actually enjoy feeling aesthetic sadness (i.e., sadness elicited by a sad movie or book) and that people tend to listen to sad music when they are alone (Juslin et al., 2008). Together with the effects of music context, our findings suggest that getting chills may be something people can control; generally, it seems that people get chills when they choose to listen to music that has special meaning and that evokes strong changes in positive and negative emotions. Future research about aesthetic chills and music listening should examine this effect.

Using experience sampling was a major strength of this study, as it allowed us to peek into everyday experiences involving music listening context and chills. In doing so, we discovered that most of the variation in chills occurs within-people, and we identified some within-person factors that are important predictors of the chills response to music. But this design also hinted at some between-person differences in these within-person effects. For example, we found that feeling worried and being around other people did not significantly influence whether people had chills for the sample overall, but these within-person effects showed significant variability. There were thus some people in the sample, for example, who were more likely to experience chills when alone and others who were more likely to experience chills when with others. Uncovering the complexity of such effects—why people differ in within-person relationships—is the next important step for research on chills in daily life.

Experience sampling is rare in aesthetics research: most research takes place in the controlled environment of a research lab. In this sense, experience sampling methods have a close kinship with the literature on aesthetic experience in museum environments (e.g., Heidenreich & Turano, 2011; Höge, 2003; Mastandrea, Bartoli, & Bove, 2007; Smith & Smith, 2001), which seeks to understand aesthetics in a realistic and important natural environment. Clearly, laboratory research is fundamental to the science of the arts, but it is equally important to understand how aesthetic experiences unfold in people's normal lives, which is where nearly all aesthetic experience happens. The current study, and others like it—for example, Tschacher et al.'s (2012) use of mobile monitoring of people's physiological responses to museum exhibits (Tröndle & Tschacher, 2012)—demonstrate the usefulness of novel research methodologies for exploring everyday aesthetic encounters such as chills. Future research using these novel methods will help us understand when and why chills and other aesthetic experiences happen in people's natural environments.

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