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Music to the inner ears: Exploring individual differences in musical imagery

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ABSTRACT

In two studies, we explored the frequency and phenomenology of musical imagery. Study 1 used retrospective reports of musical imagery to assess the contribution of individual differences to imagery characteristics. Study 2 used an experience sampling design to assess the phenomenology of musical imagery over the course of one week in a sample of musicians and non-musicians. Both studies found episodes of musical imagery to be common and positive: people rarely wanted such experiences to end and often heard music that was personally meaningful. Several variables predicted musical imagery, including personality, musical preferences, and positive mood. Musicians tended to hear musical imagery more often, but they reported less frequent episodes of deliberately-generated imagery. Taken together, the present research provides new insights into individual differences in musical imagery, and it supports the emerging view that such experiences are common, positive, and more voluntary than previously recognized.

1. Introduction

Musical imagery is widely experienced in daily life (Bailes, 2006, 2007; Liikkanen, 2008, 2011). Although previously considered an aversive experience (e.g., Levitin, 2006), an emerging literature suggests that musical imagery is experienced positively in the minds of most people (Beaman & Williams, 2010; Halpern & Bartlett, 2011; Hyman et al., 2013). These melodies of the mind can arise both involuntarily and voluntarily. Professional musicians, for example, can engage in voluntary musical imagery to enhance their own musical performance (Hodges & Sebald, 2011). Aside from such general differences between musicians and nonmusicians, little is known about how people differ more broadly in their imagery experiences. In the present research, we conducted two studies—using cross-sectional and experience sampling methods—to explore the role of personality and musical background in the phenomenology and emotional quality of musical imagery.

1.1. Musical imagery and volitional control

Researchers often distinguish between imagery that is voluntary and involuntary. Involuntary musical imagery (INMI) can occur spontaneously in the mind without conscious intent (Liikkanen, 2011); voluntary musical imagery can occur deliberately by intentionally summoning music to mind (Halpern & Zatorre, 1999) or mentally rehearsing a piece of music

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(Hodges & Sebald, 2011). Of the two types of imagery, INMI is often characterized as intrusive—the experience of having a song "stuck in the head." Despite its seemingly uncontrolled nature, recent research suggests that INMI is a pleasant experience for most people (Beaman & Williams, 2010; Halpern & Bartlett, 2011; Hyman et al., 2013).

Another theme in the musical imagery literature is that music listening increases the frequency and content of imagery (Bailes, 2006; Hyman et al., 2013; Liikkanen, 2009, 2011; Williamson et al., 2011). For example, Liikkanen (2009) asked people to complete popular song lyric stems and then work on a task unrelated to the study. A majority of people reported hearing INMI from the cued songs during the subsequent task, consistent with the idea that recently experienced music influences the content of musical imagery. Similarly, Bailes (2007) conducted an experience sampling study with undergraduate and graduate music students and found that most students experienced imagery for music they had recently heard or performed.

Voluntary musical imagery, or audiation (Walters, 1989), is often employed by musicians to mentally rehearse a piece of music. When coupled with physical rehearsal on an instrument, mental rehearsal can enhance musical performance quality (Hodges & Sebald, 2011; Ross, 1985). Bailes (2007) found that music students frequently attributed episodes of musical imagery to preparing for an upcoming performance. Although musicians can seemingly control aspects of musical imagery, the extent to which such voluntary imagery is present in the average person remains unclear.

A growing body of evidence suggests that musical imagery is associated with positive emotions. Such imagery has been linked to positive affective states prior to onset (Williamson et al., 2011) and during the experience (Bailes, 2007). Recently, Hyman et al. (2013) found that imagery was more commonly reported for songs that were liked rather than disliked. This finding is complimented by research suggesting musical imagery is rarely experienced as aversive or disruptive in daily life. Beaman and Williams (2010), for example, conducted a daily diary study and found only a small percentage of episodes to be interfering with everyday activities.

1.2. The present research

In two studies, we sought to extend the small literature on musical imagery by exploring the phenomenology of musical imagery using cross-sectional (Study 1) and experience sampling (Study 2) designs. In Study 1, we assessed the role of personality and musical value (i.e., how important music is to someone) to examine the contribution of individual differences in the frequency and phenomenology of musical imagery. The few studies that considered variation in imagery have largely focused on characteristics of unwanted "ear worms." In this present work, we were interested in exploring both involuntary and voluntary aspects of imagery.

In Study 2, the frequency and phenomenology of musical imagery were examined in daily life with an experience sampling study, using a cell phone-based, interactive voice response (IVR) system. This approach allowed us to probe the imagery experience by contacting people at random times throughout the day and asking them to fill out an automated survey on their cell phones for one week. For this study, we were particularly interested in exploring imagery in musicians and non-musicians. Previous research suggests that musicians enjoy a unique experience: they report more frequent episodes of imagery (Liikkanen, 2011) and can exert some level of control over such experiences (e.g., mental rehearsal; Bailes, 2007). But does the experience of musical imagery differ between musicians and non-musicians?

2. Study 1

Study 1 explored the prevalence and phenomenology of musical imagery using a cross-sectional approach. We asked people to report how often they had musical imagery as well as the extent to which they enjoy these experiences, find them unpleasant, experience imagery with special meaning, and deliberately improvise, rehearse, or compose musical imagery. People also completed a series of questionnaires, including personality, musical value, and genre preference measures. In light of recent research (e.g., Floridou, Williamson, & Müllensiefen, 2012), we expected personality characteristics to predict the frequency of self-reported imagery, such as openness to experience and neuroticism. We also expected people to report frequent and positive episodes of musical imagery.

2.1. Method

2.1.1. Participants

The data were collected as part of a larger study of individual differences in personality. Participants were 190 UNCG undergraduates (58 men, 132 women; mean age = 19.64, *SD* = 2.16). Students received credit toward a research option in a psychology course for their participation. Self-reported ethnicity was 61% European American, 31% African American, 7% Asian, and 7% Hispanic or Latino (students could choose more than one option).

2.1.2. Materials and procedure

The study took place in groups of 1–8. Upon entering the lab, students filled out a consent form and were briefed by an experimenter about the study. Following informed consent, students completed several computerized assessments, including personality and musical experience questionnaires.

2.1.2.1. Musical imagery. Participants completed a five-item scale of musical imagery. Each question asked people to indicate—on a scale of 0 to 10—a proportion of time in a given day that they experience the musical imagery items. Each number on the scale represented a 10% increase in frequency (e.g., 2 = 20%). First, people were asked how often they experienced musical imagery. Next, they indicated how often they enjoyed hearing this music. To assess active engagement, we asked people to indicate the percentage of time that they composed, rehearsed, or improvised musical imagery. To assess importance, we asked students how often their imagery had some special meaning. Finally, to assess cognitive control, students indicated the percent of time that they disliked musical imagery or felt like a song was stuck in their head.

2.1.2.2. Musical value. Participants rated how important music was to them (1 = *not at all important*, 7 = *extremely important*), how unpleasant it would be to go an entire day without listening to music (1 = *not at all unpleasant*, 7 = *extremely unpleasant*), and how much they cared about music (1 = *not much*, 7 = *very much*). Analysis of internal consistency between the three items was high (Cronbach's $\alpha = .99$), so we averaged them to form a composite index.

2.1.2.3. Music preferences. We measured musical preferences with the Revised Short Test of Music Preferences (STOMP-R; Rentfrow & Gosling, 2003). This scale asks people to indicate their preference for 23 genres of music on a seven-point scale, from 1 (*Dislike Strongly*) to 7 (*Like Strongly*), that represent four higher-order dimensions of music preference: Intense and Rebellious (e.g., alternative, heavy metal, and rock), Upbeat and Conventional (e.g., country, gospel, and oldies), Energetic and Rhythmic (e.g., electronica, hip-hop, and reggae), and Reflective and Complex (e.g., blues, classical, and folk). The preference dimensions correlate with other individual differences, such as personality and cognitive ability (Nusbaum & Silvia, 2011b; Rentfrow & McDonald, 2010).

2.1.2.4. Personality. Participants completed the 60-item NEO Five Factor Inventory (FFI; Costa & McCrae, 1992), a widely used assessment of five factors of personality: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Participants respond using a five-point scale (1 = *strongly disagree*, 5 = *strongly agree*).

3. Results and discussion

3.1. Data reduction and descriptive statistics

The data were analyzed with Mplus 6, using maximum likelihood estimation with robust standard errors. Table 1 displays correlations and descriptive statistics for all observed variables. Using the *r* metric, effect sizes of .10, .30, and .50 are considered small, medium, and large, respectively (Cohen, 1988).

Overall, people reported hearing musical imagery for more than half of their waking hours ($M = 6.17$, $SD = 2.80$). On average, this tended to be an enjoyable experience, as people reported more often hearing preferred music ($M = 8.78$, $SD = 2.46$) that was meaningful ($M = 6.46$, $SD = 2.89$). Interestingly, aversive musical imagery was notably low: people rarely had the unpleasant experience of having a song stuck in their heads ($M = 2.90$, $SD = 1.91$). Furthermore, the percentage of time people reported composing, rehearsing, or improvising musical imagery was low ($M = 3.01$, $SD = 2.67$). Taken together, it appears that musical imagery is common and enjoyable, yet mostly a passive process of hearing rather than creating.

3.2. Musical Value and Musical imagery

Does music value predict musical imagery? We modeled the five musical imagery items as dependent variables in a multivariate regression, predicted by the composite musical value variable. Table 2 displays *p*-values and 95% confidence intervals around the standardized effects. As expected, musical value strongly predicted the percentage of time people heard musical imagery ($\beta = .42$). Value showed a moderate effects on hearing music with special meaning ($\beta = .29$) and liking imagery ($\beta = .20$), and a small effect on how often people played an active role in composing, rehearsing, or improvising musical imagery ($\beta = .07$). The effect of value on the tendency to have music stuck in the mind was essentially zero.

3.3. Music preferences and musical imagery

Does musical preference predict musical imagery? We again modeled the five musical imagery variables as multivariate outcomes, predicted by the four preference dimensions of the STOMP. The tendency to hear musical imagery was predicted by preferences for Intense ($\beta = .16$) and Reflective ($\beta = .14$) domains. Listening to Reflective music also predicted how often people composed musical imagery ($\beta = .24$; see Table 3). People who listened to mostly upbeat music tended to hear musical imagery with special meaning ($\beta = .23$). None of the preference dimensions showed notable effects on music being stuck in the mind (all βs < .05). It thus appears that musical genres are related to positive qualities of musical imagery, but not the negative quality of having a song stuck in the mind.

Table 1
Correlations and descriptive statistics: Study 1.

	M	*SD*	*Min, Max*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Imagery: Hear	6.17	2.80	0, 10	1																	
2. Imagery: Like	8.78	2.46	0, 10	.29	1																
3. Imagery: Compose	3.01	2.68	0, 10	.28	.11	1															
4. Imagery: Meaning	6.46	2.84	0, 10	.34	.28	.22	1		.												
5. Imagery: Stuck	2.90	1.91	0, 9	.04	−.30	.09	.12	1													
6. Value: Important	5.95	1.23	1, 7	.42	.20	.12	.29	−.04	1												
7. Value: Day Without	4.81	2.01	1, 7	.35	.16	.00	.22	−.04	.55	1											
8. Value: Care	5.72	1.44	1, 7	.37	.18	.09	.28	.00	.84	.63	1										
9. Value: Average	5.50	1.37	1, 7	.42	.20	.07	.29	−.03	.86	.87	.90	1									
10. STOMP: Reflective	3.91	1.16	1, 6.63	.24	.00	.17	.05	−.07	.16	.02	.12	.10	1								
11. STOMP: Intense	4.51	1.39	1, 7	.22	−.09	.02	−.01	.00	.31	.13	.31	.27	47	1							
12. STOMP: Upbeat	4.74	1.06	1.50, 7	.08	.15	.06	.23	−.05	.08	.07	.11	.10	.16	−.15	1						
13. STOMP: Energetic	4.93	1.01	1, 7	.14	.14	−.01	.10	−.05	.16	.14	.19	.18	.35	.11	.32	1					
14. Neuroticism	3.01	.66	1.58, 4.92	.14	.00	.04	.10	.12	.06	−.02	.03	.02	.06	.15	−.09	−.09	1				
15. Extraversion	3.58	.56	2.08, 4.83	−.02	−.06	.07	.12	.02	.02	.04	.01	.03	−.06	−.07	.25	.20	−.28	1			
16. Openness to Experience	3.67	.53	2.42, 5.00	.39	.06	.16	.22	−.03	.31	.18	.29	.29	.54	.42	.01	.31	.04	.13	1		
17. Agreeableness	3.60	.48	2.25, 4.83	.06	.02	−.05	.10	.07	.01	−.01	−.01	.00	.02	−.05	.14	−.01	−.30	.11	.07	1	
18. Conscientiousness	3.51	.56	1.83, 5	−.03	.09	.08	.20	−.09	.01	.05	.01	.03	.00	−.12	.25	.09	−.36	.17	−.05	.14	1

Note: $n = 190$.

Table 2
Standardized effects of musical value on imagery phenomenology: Study 1.

	Musical value		
	β	*p*	95% CI
Hearing	.427	.000	.307, .546
Liking	.208	.007	.058, .358
Meaning	.296	.000	.169, .422
Composing	.073	.295	−.064, .210
Stuck	−.036	.634	−.182, .111

Note: $n = 190$.

Table 3
Standardized effects of musical preferences on imagery phenomenology: Study 1.

	Reflective			Intense			Upbeat			Energetic		
	β	*p*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI
Hearing	.140	.051	−.002, .685	.159	.046	.003, .649	.069	.370	−.213, .572	.061	.428	−.248, .585
Liking	−.006	.949	−.394, .369	−.095	.265	−.467, .131	.108	.164	−.103, .592	.125	.087	−.039, .642
Meaning	.001	.993	−.421, .424	.018	.821	−.282, .356	.225	.002	.209, .988	.026	.710	−.320, .470
Composing	.240	.004	.164, .965	−.067	.443	−.472, .208	.049	.518	−.254, .501	−.101	.211	−.697, .157
Stuck	−.085	.329	−.413, .142	.040	.658	−.183, .291	−.032	.680	−.311, .203	−.018	.799	−.288, .222

Note: $n = 190$.

Table 4
Standardized effects of personality on imagery phenomenology: Study 1.

	Neuroticism			Extraversion			Openness to experience			Agreeableness			Conscientiousness		
	β	*p*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI	*β*	*p*	95% CI
Hearing	.151	.044	.004, .297	−.047	.528	−.193, .099	.394	.000	.268, .520	.087	.188	−.042, .216	.037	.635	−.114, .187
Liking	.015	.827	−.121, .152	−.091	.201	−.231, .049	.081	.225	−.050, .212	.012	.867	−.172, .152	.118	.132	−.035, .271
Meaning	.252	.000	.112, .392	.108	.151	−.039, .256	.201	.001	.079, .323	.122	.063	−.007, .251	.272	.000	.151, .393
Composing	.081	.245	−.056, .218	.054	.440	−.084, .192	.166	.026	.020, .311	−.064	.403	−.216, .087	.127	.068	−.010, .264
Stuck	.164	.018	.028, .301	.081	.229	−.051, .213	−.066	.308	−.194, .061	.136	.069	−.011, .282	−.072	.257	−.198, .053

Note: $n = 190$.

3.4. Personality and musical imagery

Does personality predict a tendency to hear musical imagery? We modeled the five factors of personality from the NEO FFI as predictors of musical imagery frequency in a multivariate regression. Openness to experience showed a large effect ($\beta = .39$) and neuroticism showed a modest effect ($\beta = .15$; see Table 4) on how often people experienced musical imagery, consistent with past research (Floridou et al., 2012; Kellaris, 2003). People high in openness listen to music more frequently (Rentfrow & Gosling, 2003) and are more engaged with music (e.g., playing an instrument, going to concerts; Nusbaum & Silvia, 2011b), however, so it's not surprising that they should report hearing musical imagery more often.

Regarding phenomenology, our final analysis examined the contribution of personality to the four phenomenological variables. Regarding liking, none of the personality variables had notable or significant effects. But for composing, openness to experience showed a modest and significant effect ($\beta = .16$). This fits with the tendency for people high in openness to enjoy creative mental activities (McCrae, 1987; Nusbaum & Silvia, 2011a). Several personality variables showed significant effects on hearing musical imagery with special meaning: neuroticism ($\beta = .25$), conscientiousness ($\beta = .27$), and openness ($\beta = .20$).

The experience of having a song stuck in the mind was predicted only by neuroticism ($\beta = .16$), which is consistent with the thought disruptions that characterize this trait. This suggests that "stuck song syndrome" could be symptomatic of people high in neuroticism.

4. Study 2

Consistent with past research, Study 1 found that musical imagery was widely experienced: people reported perceiving music that was personally meaningful, liking the experience, and rarely wanting it to stop. Study 1 also found that individual differences in personality, especially openness to experience and neuroticism, predicted musical imagery phenomenology. In Study 2, we sought to replicate and extend these findings with an experience sampling study of musical imagery in daily life.

Experience sampling research repeatedly assesses thoughts, actions, and experiences in people's daily lives (Conner, Tennen, Fleeson, & Barrett, 2009; Hektner, Schmidt, & Csikszentmihalyi, 2007). When the sampling is frequent and relatively random, this method affords a unique look at how often events happen in daily life. Retrospective reports of many events are not always accurate, so experience sampling work can illuminate how often everyday events—such as hearing musical imagery—happen in daily life.

Study 2 also explored the emotional context and perceived volitional control surrounding musical imagery. We focused on the daily lives of a special population—trained musicians—to see if they report a different experience with musical imagery than non-musicians. Because exposure to music increases the frequency of self-reported imagery (Liikkanen, 2011; Williamson et al., 2011) and musicians are much higher in openness to experience (Nusbaum & Silvia, 2011b), we expected musicians to report musical imagery more often than non-musicians. Regarding volitional control, musicians can engage in voluntary musical imagery to mentally rehearse a piece of piece. But are they more likely than non-musicians to engage in voluntary imagery in daily life?

4.1. Method

4.1.1. Participants

We recruited students enrolled in music programs at UNCG (e.g., majors related to music performance and music education; $n = 26$; mean age = 21.31, $SD = 3.93$; 17 women, 9 men) and non-music-major students enrolled in psychology classes ($n = 78$; mean age = 19.15, $SD = 1.81$; 58 women, 20 men). To recruit music students, we posted fliers around the School of Music, Theatre and Dance, made announcements about the study during music classes, and e-mailed some students who had participated in a previous study of jazz improvisation (Beaty, Smeekens, Silvia, Hodges, & Kane, in press). The music students received $20 for their participation; non-music students received credit toward a research option in their psychology course.

4.1.2. Procedure

Students completed the first phase of the study in groups of 1–8. They completed a general information form and indicated a convenient 12-h period of time to receive survey calls (e.g., 8 am – 8 pm, 10am – 10 pm). The experimenter described the procedure for responding to the automated survey system. Students then completed several computerized questionnaires including NEO-FFI. We used an updated version of the Chapman and Chapman (1983) infrequency scale to screen for inattentive responding (such as rapidly clicking through questions). People who endorsed more than two of these items were excluded ($n = 2$).

4.1.2.1. Experience sampling. To administer surveys, we used an interactive voice response (IVR) system—an experience sampling method that allows participants to respond to automated surveys on their cell phones (Burgin, Silvia, Eddington, & Kwapil, 2013). Survey calls were generated from a dedicated computer using SmartQ IVR software (Telesage., 2009). Participants received calls—ten times per day for seven days—at quasi-random times within their respective 12-h periods of availability. The 12-h period was carved into 10 time periods, and people received one call at a random time within each of the 10 periods. If students could not answer their phone, they had up to 5 min to call back into the system and complete a survey. Once called, the survey system asked students to respond to a series of questions regarding their current activities and state of mind at the moment of the call. Unless otherwise noted, the survey used a seven-point response scale (1 = *not at all*, 7 = *very much*).

The survey first asked if people were currently listening to music in the environment (answered as *yes* or *no*). If they were not, the survey then asked if they were hearing musical imagery (answered as *yes* or *no*). A *yes* response to this item branched to four additional questions related to musical imagery phenomenology. First, people were asked if they liked the musical imagery. To assess whether the musical imagery episode was self-generated, the survey asked if the song was something they were composing, rehearsing, improvising, or making up. Finally, the survey asked two questions related to a sense of control and intent: students were asked if they wished the music would stop and if they were imagining the music on purpose.

Students also responded to a series of contextual questions. To assess social context, the survey asked if people were alone or with other people. To assess emotional context, the survey asked people to indicate the extent to which they felt happy, sad, and worried. The survey calls took about 1 min to complete.

People who averaged completing less than one survey per day were excluded from the analysis ($n = 4$). After exclusions, the sample comprised of 98 participants with 4,403 usable surveys.

5. Results and discussion

5.1. Descriptive statistics

Overall, the sample reported hearing musical imagery 17% of the time. This observation was substantially less than the self-reported frequency of musical imagery in Study 1 (i.e., about 60%), but consistent with past daily diary studies (e.g., Bailes, 2007). Participants reported a relatively high degree of preference for imagery episodes ($M = 4.75$, $SD = 1.99$). Further-

Table 5
Effects of context on imagery phenomenology: Study 2.

	Happy			Sad			Worried			Alone		
	b	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI
Hear	.118	.020	.019, .217	.008	.861	−.078, .093	.117	.003	.041, .193	−.037	.778	−.297, .223
Like	.157	.020	.025, .289	−.064	.394	−.211, .083	−.031	.599	−.147, .084	−.109	.439	−.386, .167
Stop	−.037	.127	−.085, .011	.025	.511	.050, .101	−.005	.872	−.064, .054	−.047	.691	−.281, .186
Purpose	.074	.050	.000, .148	−.013	.780	−.108, .081	.004	.914	−.069, .078	−.118	.274	−.330, .094
Compose	.016	.833	−.130, .161	.025	.790	−.161, .212	−.051	.533	−.220, .118	.358	.168	−.151, .866

Note: $n = 98$.

more, the extent to which people wanted musical imagery to stop was low ($M = 1.66$, $SD = 1.28$). The sample described a low degree of imagining musical imagery on purpose ($M = 1.77$, $SD = 1.38$), and the experience of composing musical imagery was relatively infrequent (16% of the time).

5.2. Multilevel analysis

We analyzed the data with multilevel models using Mplus 6. A multilevel approach is well suited for experience sampling research, as it can model the hierarchical structure of the nested questionnaire data. In this study, responses to survey items (level 1) were nested within people (level 2). Level 1 predictors were centered at the group mean (i.e., each person's own mean); level 2 predictors were centered at the sample's grand mean. Several outcomes—such as whether people heard musical imagery—were binary, so they were modeled as categorical outcomes. As a result, some coefficients are logistic regression coefficients.

We began by analyzing the effect of music listening on the likelihood of experiencing musical imagery. The total number of times people indicated they were listening to music throughout the week was modeled as a predictor of imagery. Similar to previous retrospective research (e.g., Liikkanen, 2011), we found that music listening significantly predicted the likelihood of reporting musical imagery ($b = .073$, $p = .000$): the more people listened to music, the more imagery they experienced.

5.3. Phenomenology of musical imagery

Next, we explored the role of contextual variables. The first model assessed the main effects of mood—happy, sad, and worried—on whether people were hearing musical imagery, assessed with the dichotomous musical imagery variable (0 = *no*, 1 = *yes*). People heard musical imagery when they were happy and worried, but not sad (see Table 5). This suggests that musical imagery can occur during both positive and negative affective states. In addition, being alone was not a significant predictor of musical imagery.

But do global emotions predict musical imagery attitudes and phenomenology? To explore this question, we analyzed a multivariate model, with the four contextual variables predicting the four musical phenomenological variables (i.e., liking musical imagery, wanting it to stop, imagining it on purpose, and making it up). When people were in a happy mood, they reported liking musical imagery more (see Table 5). The effects of the other contextual variables—sad, worried, and alone—did not significantly predict liking. Interestingly, being worried did not predict wanting musical imagery to stop, nor did the other contextual variables. The null effects of negative mood and significant effect of positive mood are notable, as they suggest that musical imagery is preferred, irrespective of global mood.

Regarding musical imagery composition, none of the contextual variables were significant predictors, consistent with the low base-rate of reported composition. But when people were in a happy mood, they tended to report imagining musical imagery on purpose (see Table 5), which implies a level of intent or control over musical imagery during periods of positive mood.

5.4. Music majors and musical imagery

We ran a series of analyses to see if music majors experienced musical imagery differently than other students. First, we explored whether music majors were more likely to be listening to music when called. The music major variable was used to predict the summed music listening variable. Similar to past work (e.g., Nusbaum & Silvia, 2011b), we found that music majors were more likely to be listening to music when called ($b = 4.967$, $p = .012$).

We then assessed the likelihood of hearing musical imagery as a function of major. Results showed a significant effect: music majors heard musical imagery significantly more often (see Table 6), consistent with base-rates in our sample and recent research reporting a greater frequency of imagery among musicians (Liikkanen, 2011). Music majors presumably spend more time immersed in music, and frequent exposure to music increases musical imagery.

Next, we examined whether the phenomenology of musical imagery differed between musicians and non-musicians. A multivariate model was specified, with the music major variable predicting the four musical phenomenological variables.

Table 6
Effects of music major and personality on imagery phenomenology: Study 2.

	Music Major			Neuroticism			Extraversion			Openness to Experience			Agreeableness			Conscientiousness		
	b	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI	*b*	*p*	95% CI
Hear	1.538	.000	1.082, 1.994	.495	.042	.017, .974	.065	.724	−.294, .424	1.098	.000	.619, 1.577	.342	.064	−.020, .704	.038	.872	−.423, .499
Like	.453	.185	−.216, 1.122	−.068	.721	−.439, .304	.009	.973	−.510, .527	.686	.069	−.053, 1.425	−.053	.794	−.449, .343	.265	.198	−.139, .669
Stop	−.007	.974	−.415, .402	−.116	.408	−.393, .160	−.083	.460	−.302, .137	.107	.394	−.138, .352	.208	.209	−.116, .532	−.498	.006	−.854, −.141
Purpose	.100	.706	−.418, .617	−.159	.427	−.550, .233	−.135	.510	−.539, .268	.563	.019	.091, 1.036	−.287	.203	−.728, .154	.112	.617	−.327, .551
Compose	−.614	.037	−1.91, −.038	−.058	.866	−.730, .614	.505	.250	−.356, 1.365	.043	.928	−.888, .973	−.192	.546	−.814, .430	−.413	.157	−.984, .159

Note: $n = 98$.

Interestingly, music majors were less likely than non-majors to report making up their own musical imagery (i.e., composing; $b = -.614$, $p = .037$). This finding is notable in light of musicians' tendency to engage in deliberate musical imagery, such as mental rehearsal (Hodges & Sebald, 2011). Regarding the other phenomenological variables, however, no differences emerged across groups. Taken together, musicians and non-musicians appear to share a common set of phenomenological experiences, but non-musicians engage in more self-generated imagery.

5.5. Personality and musical imagery

Our next analysis explored the relation between personality and musical imagery. At the within-person level, we modeled the responses to the phone survey items; at the between-person level, we modeled individual differences in personality, assessed by the NEO-FFI.

First, we examined the tendency to experience imagery as a function of personality. A model with the five personality factors of the NEO predicting the dichotomous musical imagery variable produced an intriguing pattern of effects. Similar to Study 1, we found a significant effects of openness to experience ($b = 1.098$, $p < .001$) and neuroticism ($b = 0.495$, $p = .042$; see Table 6). To test the robustness of these effects, we ran a separate model with the music major variable as a covariate. The effect of openness decreased but remained significant ($b = 0.734$, $p = .005$), the effect of neuroticism increased slightly ($b = 0.541$, $p = .010$), and the effect of music major remained stable ($b = 1.225$, $p < .001$).

Next, we examined the phenomenology of musical imagery as a function of personality. A multivariate model was specified, with the five personality variables predicting the four musical imagery variables. As with previous analyses, openness was the strongest predictor of musical imagery experiences: it showed a marginal effect on the tendency to like musical imagery ($b = 0.686$, $p = .069$) and a significant effect on imagining musical imagery on purpose ($b = 0.563$, $p = .019$). When the music major variable was added to the model, the effect of openness on liking musical imagery reached conventional significance ($b = 0.675$, $p = .039$), and the effect of openness on imagining imagery on purpose remained stable ($b = 0.622$, $p = .007$).

Regarding a desire for musical imagery to stop, conscientiousness showed a negative effect ($b = -.498$, $p = .006$). None of the personality variables predicted creating musical imagery. Importantly, unlike Study 1, the effect of neuroticism did not significantly predict wanting musical imagery to stop. In sum, although people high in neuroticism and openness were more likely to experience imagery, only openness predicted variation in phenomenology (i.e., liking imagery and imaging it on purpose).

6. General discussion

The present research supports the emerging view that musical imagery is a positive experience (Beaman & Williams, 2010; Halpern & Bartlett, 2011; Hyman et al., 2013), and presents a new look at individual differences in daily life experiences. In Study 1, a cross-sectional assessment of musical imagery found notable effects of personality, musical value, and genre preferences. In Study 2, an experience sampling study found an increased frequency of musical imagery in musicians; however, they were surprisingly less likely to report engaging in self-generated imagery. Furthermore, individual differences in personality predicted imagery phenomenology, controlling for musicianship. Taken together, this work extends the literature on musical imagery by capturing the phenomenology and emotional quality of musical imagery in everyday life.

Study 1 provides a first look at the role of musical preferences in imagery experiences. Preferences for reflective and complex (e.g., classical, jazz, and folk) and intense (e.g., alternative, heavy metal, and rock) musical genres predicted imagery frequency, but only the reflective and complex dimension was related to composing imagery. In addition, liking upbeat music (e.g., country, gospel, and oldies) predicted experiencing imagery with special meaning. This pattern of effects appears to map onto characteristics of the preference domains. For example, upbeat music, such as gospel music, typically contains lyrics with a positive emotional quality. People who listen to these genres may thus experience a sustained positive mood throughout the day—even when they aren't listening to music—due to recurring thoughts of preferred music. Future research should further explore the effects of music genres and imagery quality, to determine the residual psychological effects of music listening on emotion well-being.

Regarding personality, in Study 1, openness to experience strongly predicted the frequency and phenomenology of musical imagery, and neuroticism was the only predictor of feeling like a song was stuck in one's mind. The effect of neuroticism lends support to past work on personality and retrospective reports of musical imagery (e.g., Floridou et al., 2012; Kellaris, 2003). Results from the experience sampling analysis in Study 2, however, found that people high in neuroticism did not report wanting musical imagery to cease in their daily lives. The discrepancy between Study 1 and Study 2 highlights the merits of using experience sampling methods: retrospective studies can be useful for gathering preliminary data on a given phenomenon, but they fall short of the ecological validity of sampling momentary experiences dozens of times in the real world.

The personality findings prompt interesting questions about the imagery experiences of people high in neuroticism and openness. Although both personality types reported more frequent episodes, only openness predicted imagining music on purpose. This distinction may reflect characteristic thinking styles of these traits: neurotic people have difficulty controlling their thoughts, and thus may have less discretion and control over the songs in their heads; conversely, open people actively

engage with their thoughts, and thus may feel in control of their imagery experiences. Since open people reported a greater sense of purposeful imagery, perhaps they experience more voluntary episodes and fewer involuntary episodes. The present research did not explicitly distinguish between different types of imagery, so future work should further examine the extent to which musical imagery can be consciously controlled.

Our analysis of musicians and non-musicians revealed phenomenological similarities and differences. Although musicians tended to hear musical imagery more often, this was not surprising: their exposure to music is greater than most people, and exposure to music strongly predicts INMI prevalence (Bailes, 2006, 2007; Liikkanen, 2011; Williamson et al., 2011). Interestingly, regardless of major, the sample on average did not report a desire for musical imagery to cease. This suggests that people rarely had the unpleasant experience of having a song stuck in their minds.

Perhaps the most surprising finding was that musicians were less likely to engage in self-generated musical imagery. Trained musicians can deliberately exploit their mental imagery—for example, to mentally practice a piece of music (Hodges & Sebald, 2011). But the present results suggest that they do not intentionally generate musical images more often than the average person in daily life. Nevertheless, the act of composing such imagery could foreseeably be interpreted differently by a trained musician. We used a broad definition of "self-generated" and described different forms to participants before the study (composing, rehearsing, improvising, or making up), so anything from riffing on a simple melody to a arranging a four-part harmony thus qualified as "composing." Music performance majors, who focus less on musical composition, might also rarely compose inner music; on the other hand, jazz improvisation majors, who often compose spontaneous music, might often improvise musical imagery. In addition, our sample of non-majors might have included some people who play music recreationally or compose their own music, which could account for some of the variance explained by non-majors in composing their own imagery. This study offers a first look at self-generated musical imagery in a diverse sample, but future work should more closely examine this issue in both musicians and non-musicians.

Regarding mood, people reported hearing musical imagery in both positive (happy) and negative (worried) affective states. The effects of positive mood replicate and extend recent research on pleasantness of musical imagery (e.g., Beaman & Williams, 2010; Hyman et al., 2013). At first glance, the effects of negative mood might imply that musical imagery was anxiety-provoking to some people. But further analysis revealed that worry did not predict a desire for musical imagery to stop, so it seems unlikely that the anxious feelings were caused by the musical imagery.

An interesting question is whether musical imagery serves a self-regulatory purpose. Music listening improves mood and relieves stress (Thayer, Newman, & McClain, 1994), so perhaps musical imagery functions similarly. Do people intentionally imagine music to change their mood? Does the unconscious mind intervene during periods of emotional distress with a pleasant musical memory? Future research should take a closer look at the role musical imagery in positive mood. Although many important questions remain, the present research provides support for the emerging view that musical imagery is a positive experience, and offers a first look at individual differences in everyday musical imagery.

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