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Musical Minds: Personality, Schizotypy, and Involuntary Musical Imagery

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Involuntary musical imagery—music popping into your head that is not present in the environment—is a common experience, but relatively little is known about individual differences in involuntary musical imagery. The present research examined the Involuntary Musical Imagery Scale (IMIS), a promising new measure that assesses the frequency and qualities of involuntary musical imagery, in relation to broad personality traits and schizotypy. A sample of 182 young adults completed the IMIS along with measures of personality (the HEXACO-100; NEO-PI-3 Openness) and schizotypy (the brief Wisconsin Schizotypy Scales). Openness to experience, neuroticism (HEXACO Emotionality), and positive schizotypy traits were correlated with the frequency of involuntary musical imagery as well as with many of its facets. Overall, the IMIS seems promising for exploring individual differences in involuntary experiences of musical imagery.

Keywords: involuntary musical imagery, Involuntary Musical Imagery Scale (IMIS), inner music, personality, schizotypy

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Musical imagery—hearing music in your mind that isn't playing in the environment—is a common experience (Williams, 2015). Research has sought to describe what it is like and how often it happens, with emphasis on *involuntary musical imagery* (*INMI*), sometimes referred to as *earworms*. Liikkanen (2012) found that about 90% of people experience INMI at least once a week and typically hear songs they are familiar with; other researchers have found similar results with INMI (Floridou & Müllensiefen, 2015; Halpern & Bartlett, 2011; Hyman et al., 2015) and musical imagery more broadly (Bailes, 2006; Beaty et al., 2013). In addition, research has found that people generally consider these to be positive experiences (Bailes, 2007; Beaman & Williams, 2010; Beaty et al., 2013; Floridou & Müllensiefen, 2015; Halpern & Bartlett, 2011; Hyman et al., 2015).

Although most research has examined what INMI and general musical imagery experiences are like, the present research focuses on INMI and how different aspects of these experiences relate to personality and schizotypy. To date, only a handful of studies have considered the role of personality traits in the experience of INMI and musical imagery more generally. Beaty et al. (2013) examined the Big 5 personality traits and general musical imagery using both experience sampling measures and retrospective surveys. In both cases, openness to experience—and, to a lesser extent, neuroticism—were related to how often people heard inner music. Similarly, Kellaris (2001) found that people higher in neuroticism experience INMI more frequently. These studies, however, did not examine how personality relates to different aspects of INMI experiences. Floridou, Williamson, and Müllensiefen (2012) found that, of the Big 5 personality traits, neuroticism and openness to experience were related to different aspects of INMI. Specifically, people high in neuroticism had longer episodes of INMI, found them more worrying, felt they were interfering with daily activities, and saw these experiences as more unpleasant; people higher in openness had longer episodes and felt their INMI interfered with their daily activities. From this small collection of studies, it appears that openness to experience and neuroticism relate to both INMI and general musical imagery experiences.

Additionally, some research has examined how INMI is associated with general mental control abilities and schizotypy. Schizotypy is a construct that represents the continuum of risk, from normal to clinical, for schizophrenia and related disorders (Kwapil, Barrantes-Vidal, & Silvia, 2008). Schizotypal experiences commonly sort into two broad factors: positive symptoms associated with deviant beliefs and experiences, and negative symptoms associated with diminished pleasure and motivation (Kwapil, Gross, Silvia, & Barrantes-Vidal, 2013). Mental slippage—low cognitive control—is a defining deficit in people with schizophrenia (Wongupparaj, Kumari, & Morris, 2015), and it is apparent in less severe forms in people with elevated schizotypy scores. Lower control in schizotypy is associated with reduced filtering of auditory stimuli as well as aberrant sensory experiences (Croft, Lee, Bertolot, & Gruzelier, 2001; Ettinger et al., 2015). This suggests that people high in schizotypy are more likely to experience involuntary imagery—specifically auditory imagery (Ettinger et al., 2015; Gray, Snowden, Peoples, Hemsley, & Gray, 2003; Lagioia, Van De Ville, Debbané, Lazeyras, & Eliez, 2010).

Beaman and Williams (2013) explored the roles of mental control, using the White Bear Suppression Inventory (Wegner & Zanakos, 1994), and schizotypy (Raine, 1991). Raine's (1991) measure of schizotypy consists of three factors—*Cognitive-Perceptual* (unusual perceptual experiences and magical thinking), *Interpersonal* (social anxiety, constriction of affect), and *Disorganized* (odd behaviors and speech). Lower mental control was associated with difficulty in stopping earworms; both lower mental control and higher schizotypy—

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particularly the cognitive-perceptual factor—were associated with feeling that the earworm was disrupting daily activities and the self-reported duration of the earworms (Beaman & Williams, 2013). Similarly, Hyman et al. (2015) found that lower mental control was associated with more instances of INMI as well as higher frequency of involuntary thoughts. Physical anhedonia—a component of negative schizotypy that reflects diminished pleasure from sensory and physical experiences (Kwapil et al., 2008)—had small negative effects on how often people experienced general musical imagery in two studies (Nusbaum, Silvia, Beaty, Burgin, & Kwapil, 2015).

Assessment has been a barrier to progress in studying individual differences in musical imagery. The experience of inner music is measured inconsistently across studies, usually with ad hoc scales and often with only a single item. In response to this lack of consistent measurement, the Involuntary Musical Imagery Scale (IMIS; Floridou, Williamson, Stewart, & Müllensiefen, 2015) was recently developed to provide a standard assessment for several components of INMI. The IMIS identifies four aspects of INMI: *negative valence* (whether people find the inner music pleasant or irritating), *movement* (whether people physically move in response to the music), *personal reflections* (whether the music is triggered by or related to personal concerns, goals, or worries), and *help* (whether the inner music contributes to or interferes with ongoing activities). This scale also has single items that measure the *frequency* of musical imagery and the *duration* of the imagery (both the length of the entire experience and the section of music that is repeating).

To date, the IMIS has good evidence for reliability and preliminary evidence for validity. Floridou et al. (2015) found relationships between the IMIS factors and measures of musical expertise, perhaps the most commonly studied individual-difference factor in this literature. The five aspects of musical expertise measured (*musical training*, *active engagement*, *perceptual abilities*, *singing abilities*, and *emotions*; Müllensiefen, Gingras, Musil, & Stewart, 2014) were primarily related to the *movement* and *help* subscales of the IMIS as well as to the overall frequency of INMI experiences. Similarly, the ability to vividly imagine sounds, measured with the Bucknell Auditory Imagery Scale (Halpern, 2015), was related to higher scores on the *movement* subscale and higher earworm frequency, but the ability to exert control over auditory imagery was not related to any aspects of the IMIS. Additionally, people higher in daydreaming reported more frequent and longer episodes of earworms, and daydreaming was positively related to each of the four IMIS subscales. Similarly, cognitive intrusions were positively correlated with the four IMIS subscales, *frequency* of INMI, and *episode length*. Reports of higher levels of obsessive–compulsive symptoms were positively related to the *negative valence*, *movement*, and *personal reflections* subscales. It should be noted, however, that the relationships with the IMIS were mostly small and moderate in size (the largest $r = .39$).

In the present research, we sought to expand the evidence for the validity of the IMIS and to extend it to the study of broad personality traits. Surprisingly few studies have evaluated how the traits described in major models of personality relate to inner music (Beaty et al., 2013; Kellaris, 2001; Floridou et al., 2012). Examining the IMIS in light of broader personality traits both informs its validity and illustrates its usefulness for understanding INMI more generally. The present study thus explored the IMIS in light of broad personality traits—measured with the HEXACO-100 (Lee & Ashton, 2004)—as well as schizotypy, measured with the Wisconsin Schizotypy Scales (Winterstein et al., 2011). Given previous research (Beaman & Williams, 2013; Beaty et al., 2013; Floridou et al., 2012; Kellaris, 2001), we expected that openness to experience, neuroticism, and schizotypy would be associated with the frequency of musical imagery experiences. Additionally, we expected openness to experience and neuroticism to relate to several aspects of INMI examined by the IMIS. Openness to experience should be particularly salient in light of its central role in creativity, imaginative experience, and musical engagement (Kaufman, 2013; Kaufman et al., 2016; Thomas, Silvia, Nusbaum, Beaty, & Hodges, 2016). Previous work has found schizotypy is related to the length of earworm episodes instead of their frequency (Beaman & Williams, 2013), but if frequency is affected by a "leaky" cognitive filter that limits control over imagery (Croft et al., 2001; Granger, Moran, Buckley, & Haselgrove, 2016; Kaufman & Gregoire, 2016), we would expect positive schizotypal symptoms to be associated with more frequent INMI.

Method

Participants

A total of 210 undergraduate students volunteered as part of a class research participation option in a psychology class. Participants who had elevated scores on scales and items intended to capture inattentive, random, and fake-bad responding were omitted (see Maniaci & Rogge, 2014; McKibben & Silvia, in press, 2016), resulting in a final sample size of 182. The sample was primarily young (M age = 19.10, SD = 3.44, range of 18 to 53) and female (n = 139; 76%), and it was diverse according to self-reported race and ethnicity (59% European American, 34% African American, and 8% Hispanic/Latino). This research was approved by the university's Institutional Review Board, and all participants provided informed consent before completing the study.

Procedure

People participated in small groups ranging from 1 to 8 and completed the following measures on computers using MediaLab, 2012.

Involuntary Musical Imagery Scale. This 18-item scale measures the subjective experiences of INMI—defined by the scale as "the experience of a short section of music that comes into the mind without effort and then repeats" (p. 29)—on four factors: *negative valence* (e.g., *I find my earworms irritating*; 7 items), *movement* (e.g., *The way I move is in sync with my earworms*; 3 items), *personal reflections* (e.g., *Personal issues trigger my earworms*; 3 items), and *help* (e.g., *I find my earworms help me focus on the task that I'm doing*; 2 items; Floridou et al., 2015). The items were rated on a scale from 1 (*Always*) to 5 (*Never*), and the scores were then reversed so that higher scores would indicate higher ratings of *negative valence*, *movement*, *personal reflection*, and *help*. The IMIS also measures, with single items, the frequency of INMI episodes (*Never*; *Once a month*; *Once a week*; *Several times a week*; *Several times a day*; *Almost continuously*), how long each episode tends to last (*Less than 10 min*; *Between 10 min and half an hour*; *Between half an hour and 1 hour*; *Between 1 and 3*

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hours; *More than 3 hours*), and how long the section of repetitive music is (*Less than 5 seconds*; *Between 5 and 10 seconds*; *Between 10 and 30 seconds*; *Between 30 seconds and 1 minute*; *More than 1 minute*). Participants were asked to think about their experiences of INMI and to rate the characteristics of a typical INMI experience rather than one specific INMI experience.

Personality traits. We measured the major factors of personality with the HEXACO-100 (Lee & Ashton, 2004), which measures six domains of personality: Honesty-Humility, Emotionality (Neuroticism), eXtraversion, Agreeableness, Conscientiousness, and Openness to Experience. All items were rated on a scale from 1 (*Strongly Agree*) to 5 (*Strongly Disagree*). Each factor has four facets. Given past work, we focused on the facets for emotionality (*fearfulness*, *anxiety*, *dependence*, and *sentimentality*) and openness to experience (*aesthetic appreciation*, *inquisitiveness*, *creativity*, and *unconventionality*).

To gain more detail about openness to experience, we included the Openness to Experience items from the NEO-PI-3 (McCrae & Costa, 2010), which provides a global score as well as scores for 6 facets: *fantasy*, *aesthetics*, *feelings*, *actions*, *ideas*, and *values*. Each item was rated on a scale from 1 (*Strongly Agree*) to 5 (*Strongly Disagree*).

Wisconsin Schizotypy Scales, Short Form. This 60-item scale measures two facets of positive schizotypy—magical ideation and perceptual aberration (Winterstein et al., 2011). The magical ideation subscale (15 items) addresses beliefs in implausible causality (e.g., *The hand motions that strangers make seem to influence me at times*; *I have felt that there were messages for me in the way things were arranged*), and the perceptual aberration subscale (15 items) addresses distortions in perception (e.g., *I have sometimes had the feeling that my body is decaying inside*; *I sometimes have to touch myself to make sure I'm still there*). This scale also measures two facets of negative schizotypy—physical anhedonia and social anhedonia. The physical anhedonia subscale (15 items) focuses on lack of pleasure from sensory and aesthetic experiences (e.g., *The beauty of sunsets is greatly overrated*; *I do not understand why people enjoy looking at the stars at night*), and the social anhedonia subscale (15 items) focuses on lack of interest in social contact and indifference to others (e.g., *I prefer watching TV to going out with other people*; *People who try to get to know me better usually give up after a while*). All items were endorsed as being true or false, and higher scores reflect increasingly deviant responses.

Results

Internal consistency was strong for the four subscales of the IMIS: *Negative Valence* (7 items; $\alpha = .88$); *Movement* (3 items; $\alpha = .85$); *Personal Reflection* (3 items; $\alpha = .72$); and *Help* (2 items; $\alpha = .79$). As noted earlier, the IMIS yields scores for the frequency and duration of INMI as well as for four qualities of INMI. Table 1 displays the correlations within the IMIS factors as well as between the IMIS and the measures of personality and schizotypy. These coefficients are best understood as effect sizes (Cumming, 2012) that reflect the magnitude of the relationships. We have, however, included statistical significance in Table 1 for interested readers. Conventional thresholds for effect sizes in the *r* metric are .10 (small), .30 (medium), and .50 (large).

Personality and the IMIS

Frequency. The frequency of INMI was most strongly related to openness to experience ($r = .29$), as measured with the NEO, and its fantasy facet ($r = .31$). The aesthetics, feelings, and values facets were less strongly related to frequency. Measured with the HEXACO, openness to experience was more weakly related to INMI frequency ($r = .19$); the largest HEXACO facet effect was for aesthetic appreciation ($r = .24$). Emotionality and its facets were not related to reported frequency.

Duration. Personality was largely unrelated to the reported duration of both INMI episodes and sections of music within episodes. No effect size was larger than $r = \pm .20$. Only the aesthetics ($r = .15$) and feelings ($r = .15$) NEO openness facets were weakly related to the musical *section length*, and the fantasy NEO openness facet was weakly related to the *episode length* ($r = .16$). The HEXACO emotionality and openness factors and their respective facets were unrelated to both forms of duration.

IMIS subscales. Personality was differentially related to each of the four IMIS subscales. *Negative valence* was unrelated to personality, except for a small correlation with the dependence facet of emotionality ($r = .16$). *Movement*, on the other hand, was related to NEO openness to experience ($r = .25$) and several of its facets (fantasy, aesthetics, and feelings). *Personal reflections* was most strongly correlated with emotionality ($r = .21$) and its anxiety facet ($r = .23$), along with the feelings facet ($r = .23$) of NEO openness to experience. Finally, *help* was positively related to overall NEO openness to experience ($r = .22$) and several facets, particularly NEO ideas ($r = .31$) and HEXACO unconventionality ($r = .23$).

Schizotypy and the IMIS

Frequency. As expected, positive and negative schizotypy had different relationships with INMI. Magical ideation ($r = .17$) and perceptual aberration ($r = .19$), the positive facets, were associated with more frequent INMI. Physical anhedonia and social anhedonia had small and negative effects, as in past work (Nusbaum et al., 2015).

Duration. The duration of inner music was largely unrelated to schizotypal traits. Physical anhedonia was negatively correlated with *section length* ($r = -.17$): people higher in physical anhedonia reported experiencing briefer sections of musical imagery.

IMIS subscales. Positive schizotypy was related to several of the IMIS subscales. People high in magical ideation had higher scores on the *movement* ($r = .32$), *personal reflections* ($r = .30$), and *help* ($r = .27$) subscales; people high in perceptual aberration had higher scores on the *movement* ($r = .27$) and *personal reflections* ($r = .29$) subscales. The negative schizotypy facets did not significantly correlate with any of the four IMIS subscales.

Discussion

How does personality influence the experience of INMI? The present research evaluated the IMIS, a new assessment tool for research on INMI. The findings extended the evidence for the IMIS's reliability and validity and expanded the growing literature on personality and INMI and musical imagery more generally (Beaman & Williams, 2013; Beaty et al., 2013; Floridou et al., 2012; Kellaris, 2001; Nusbaum et al., 2015).

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Table 1
Correlations of the Involuntary Musical Imagery Scale With Personality and Schizotypy

Variable	Negative valence	Movement	Personal reflections	Help	INMI frequency	INMI length (Section)	INMI length (Episode)
INMI characteristics							
Negative valence	1						
Movement	.06	1					
Personal reflections	.26***	.42***	1				
Help	−.28***	.36***	.28***	1			
INMI frequency	−.19*	.26***	.12	.24***	1		
INMI length (Section)	.11	.13	.18*	.12	.13	1	
INMI length (Episode)	.14	.12	.04	−.03	.19*	.21**	1
HEXACO							
Honesty-humility	−.06	−.08	−.11	−.03	.04	.02	−.08
Emotionality	.12	.18*	.21**	.04	.04	.06	.14
Fearfulness	.00	.08	.03	−.03	−.02	−.05	.02
Anxiety	.12	.11	.23**	.04	.00	.07	.15*
Dependence	.16*	.13	.16*	.08	.14	.09	.13
Sentimentality	.05	.17*	.18*	.04	.00	.06	.08
Extraversion	−.01	.05	−.08	.08	.04	−.06	−.02
Agreeableness	−.09	.04	−.05	.01	.11	.05	−.04
Conscientiousness	.03	−.09	−.01	.00	−.08	.04	.00
Openness to experience	.04	.14	.11	.18*	.19*	.13	−.02
Aesthetic appreciation	.00	.12	.06	.13	.24**	.12	−.05
Inquisitiveness	.10	−.05	.14	.09	−.03	.10	−.04
Creativity	.04	.16*	.00	.12	.19*	.13	.06
Unconventionality	−.03	.22**	.17*	.23**	.14	.02	−.02
NEO							
Openness to experience	−.04	.25***	.11	.22**	.29***	.14	.08
Fantasy	−.05	.27***	.10	.09	.31***	.05	.16*
Aesthetics	.01	.25***	.09	.18*	.24**	.15*	.02
Feelings	−.01	.25***	.23**	.12	.16*	.15*	.10
Actions	−.07	.03	−.13	.04	.08	.09	.02
Ideas	−.04	.09	.13	.31***	.10	.08	−.04
Values	−.01	.05	−.03	.08	.20**	.01	.06
Wisconsin Schizotypy scales							
Magical ideation	−.11	.32***	.30***	.27***	.17*	.12	−.06
Perceptual aberration	.03	.27***	.29***	.13	.19*	.08	.07
Physical anhedonia	−.06	−.01	.04	−.08	−.12	−.17*	−.07
Social anhedonia	.06	.05	.10	−.08	−.15*	.00	.04

Note. $n = 182$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

For the *frequency* of INMI, the major relationships were with openness to experience and positive schizotypy, consistent with their broader roles in imagination and vivid inner experience (Kaufman, 2013; Kwapil et al., 2008). For the duration of INMI, however, few effects appeared. The largest observed effect sizes—$r = -.17$ for *section length* and $r = .16$ for *episode length*—were fairly small and identical to the largest observed effect size for length in past work ($r = .16$; Floridou et al., 2015, p. 32). It's possible that the constructs studied thus far aren't important to variation in imagery duration, but it is worth considering in future work how well people can encode and recall the length of typical auditory imagery experiences.

The effects for the four IMIS subscales were theoretically consistent. *Movement*, a marker of the intensity or vividness of INMI, correlated primarily with openness to experience and positive schizotypy. This finding is not surprising given that people higher in openness are more deeply engaged in aesthetic experiences (Nusbaum & Silvia, 2014; Silvia & Nusbaum, 2011). *Personal reflections*, a marker of whether INMI was linked to concerns or worries, correlated primarily with emotionality and positive schizotypy. *Help*, a marker of whether INMI furthered ongoing activity, correlated primarily with openness to experience. *Negative valence*, however, had few notable relationships, and its largest effect size (with emotionality's dependence facet) was small ($r = .16$). This is surprising, perhaps, because negative valence is thought to be a cardinal feature of earworms (Williams, 2015) and because the negative valence subscale makes up over half of the IMIS.

Our findings reinforce the growing evidence for the central role of openness to experience in musical imagery. In both past research (Beaty et al., 2013) and the present findings, openness to experience and its facets are important correlates of both the frequency and qualities of musical imagery. These findings fit with the broader role of openness to experience in imagination, daydreaming, emotional complexity, and musical engagement (Greenberg, Müllensiefen, Lamb, & Rentfrow, 2015; Kaufman, 2013; Thomas et al., 2016) and suggest that future research should seek to isolate why openness to experience is so prominent in musical imagery.

In addition, our findings suggest that the role of schizotypy in musical imagery is complex and deserves more attention. The

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present study found that two aspects of positive schizotypy—magical ideation and perceptual aberration—were associated with more frequent INMI. Negative schizotypy—physical and social anhedonia—had small negative effects, consistent with past research (Nusbaum et al., 2015). A prior study, however, found an association between schizotypy and duration, not frequency (Beaman & Williams, 2013). Both studies used different assessments of musical imagery and different measures of schizotypy. The schizotypy scales, in particular, have different subscales, factors structure, and research traditions (see Kwapil et al., 2008). In any case, as a pair the studies suggest that exploring the role of schizotypy in INMI is likely to be fertile.

Overall, the IMIS appears promising as a tool for studying individual differences in INMI. Future research should evaluate several of the factors in more detail, particularly INMI duration and *negative valence*, which yielded at most small effect sizes in this study and in past research (Floridou et al., 2015). In addition, future work should consider the construct breadth of the IMIS. Although often involuntary, musical imagery is often under intentional control, such as when people are rehearsing, composing, or performing music (e.g., Gregg, Clark, & Hall, 2008; Keller, 2012; Saintilan, 2014) or when people elaborate or modify the music in their mind (e.g., changing the lyrics, key, or melody, or deliberately skipping or repeating segments). It would be worth evaluating whether voluntary and involuntary forms of musical imagery have similar facets and if they share similar relationships with broader dimensions of personality.

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