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Personality and engagement with music: Results from network modeling in three adolescent samples

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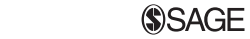

Nicolas Ruth[1], Elina Tsigeman[2], Maxim Likhanov[2], Yulia Kovas[1] and Daniel Müllensiefen[1]

Abstract

People who engage in musical activities may, on average, share certain personality features. For example, performing music in front of audiences may require greater extraversion. In contrast, long and solitary practice sessions may require greater introversion and conscientiousness. Research has established some links between dimensions of personality and indicators of engagement with music, for example, specific personality profiles for musicians/non-musicians. For example, openness is usually linked to musical involvement. However, research in the area is scarce and it remains unclear which specific aspects of musical engagement are linked to personality; how these links establish in the course of development; and whether these links are affected by culture. This article reports data collected with several measures of personality (Big Five personality scales) and a comprehensive measure of engagement with music—the musical sophistication index (Gold-MSI) in three countries: Germany ($N = 1{,}114$), Russia ($N = 346$), and the United Kingdom ($N = 751$). We applied a graphical network modeling approach to investigate the patterns of association among the measures. Our results found a number of consistent musical sophistication-personality associations across the three samples, with the strongest link being between the Gold-MSI emotions subscale and the personality trait openness, which was found in all three samples.

Keywords

Big Five, musicality, musical training, pupils, transnational

[1]Department of Psychology, Goldsmiths, University of London, London, UK
[2]Sirius University of Science and Technology, Sochi, Russia

Corresponding author:
Nicolas Ruth, Institute for Cultural Management and Media, University of Music and Theatre Munich, Arcisstrasse 12, 80333 Munich, Germany.
Email: nicolas.ruth@hmtm.de

Research has demonstrated links between musicality and personality (e.g., Butkovic et al., 2015; Corrigall et al., 2013; McCrae & Greenberg, 2014). For example, Müllensiefen et al. (2014) developed a self-report measurement for musical sophistication and conducted a large online study with a comprehensive sample and various lab studies to test and validate the instrument. One of their lab studies focused on associations with personality traits and revealed a correlation of .43 between musical sophistication and openness to experience, a personality trait that is linked to sensitivity to art and beauty, intellectual curiosity, and imagination (Müllensiefen et al., 2014). The results of a musical ear test were also positively associated ($\beta = .28$) with the openness to experience personality trait (Thomas et al., 2016) and subdimensions of the traits extraversion (βs from .05 to .09 in stepwise multiple regressions), agreeableness (βs from .05 to .06), and openness to experience (βs from .32 to .43) were positively linked to musical sophistication (Greenberg et al., 2015). However, research has only yet started exploring the associations between modern concepts of musicality like musical sophistication or the consistency of links between personality and musicality across different samples. This article extends musicality–personality research by applying network modeling to multidimensional data from three adolescent samples drawn from three different cultures.

Theoretically, personality and musicality may be linked causally in both directions, that is, have reciprocal links. Conceptualization of personality suggests that it drives behavior and experience and therefore, can affect one's self-concept, personal strivings and attitudes (McCrae & Costa, 2008), including interest in music and musicality. However, personality traits may be affected by music. For example, musical engagement involves much practise, social interaction, and learning, potentially affecting personality (Hallam, 2010).

Historically, links between engagement in music and personality have been primarily investigated in professional musicians (Gillespie & Myors, 2000; Kemp, 1996; Rose et al., 2019; Woody, 1999). For example, Kemp (1996) compared groups of music students, professional musicians, and non-musicians in a comprehensive study. He concluded that musicians are higher on introversion, anxiety and intelligence than non-musicians. In addition, a case study on a musicians' biography indicated that openness is a key correlate of musical expertise, as measured by the degree of skill on a musical instrument (McCrae & Greenberg, 2014). However, the findings from such studies are limited to people performing professionally in specific musical genres, such as classical, rock, and pop.

Another stream of research has focused not only on professional musicians but on a more general population by predicting personality using musical preferences (e.g., Devenport & North, 2019; Ruth & Müllensiefen, 2020). One comprehensive study has indicated that musical preference and engagement develop over time and that this development is associated with personality (Bonneville-Roussy et al., 2013). For example, it has been shown that people scoring high on openness to experience show greater (half of a standard deviation) preference for mellow music than people low on openness. However, a meta-analysis has shown that the associations between musical preferences and personality are rather weak when using Cohen's benchmarks (Schäfer & Mehlhorn, 2017).

A third research approach is to examine the associations between musical practise and different psychological characteristics, including personality. Existing evidence indicates that pupils who take piano lessons show higher self-esteem and receive better grades in music class (Costa-Giomi, 2004); musical practise is associated with IQ ($r = .07$) and openness ($r = .31$) as shown in a comprehensive twin study (Butkovic et al., 2015); a music school program has a positive impact on verbal memory skills compared to a control group with no extended musical training at school ($\eta^2 = .21$) in an experimental setting (Roden et al., 2012); musical instrument exercises are positively related to academic achievement in four school subjects (Cohen's d range: 0.28–0.44; Guhn et al., 2019);

and a quasi-experimental study showed musical training has a positive long-term influence on academic achievement in foreign language acquisition (Yang et al., 2014). Additionally, some studies use music listening skills like rhythm, melody, or chord discrimination as an indicator for musical abilities and activities and show that those skills are associated with early reading abilities ($r = .57$; Anvari et al., 2002). One longitudinal cohort study showed long-term associations between musical family activities and family dynamics, reflected in children's personality and prosocial behavior (Kreutz & Feldhaus, 2020).

There are also several studies investigating the associations between personality and different musicality dimensions in a general population. Evidence shows that personality predicts musical involvement (taking music lessons), with openness (partial correlation: $pr = .18$) as one of the best predictors in a hierarchical regression (Corrigall et al., 2013). In another study children's openness (rated by parents) correlated with their musical training ($r = .24$; Corrigall & Schellenberg, 2015). A comprehensive twin study yielded comparable results showing that openness ($pr = .19$) and music flow ($pr = .41$) are strong predictors for musical practise in a hierarchical multiple regression (Butkovic et al., 2015). The study also showed that common genetic factors influence musical practicing behavior, artistic interests (openness) and musical enjoyment (flow). Another study of 5,808 Spotify users revealed that personality traits can be predicted from musical preferences and music listening behavior with some accuracy (varying from .26 to .37; Anderson et al., 2021).

Research has also shown links between personality and music perception. For example, one study showed that extraversion was positively associated with emotion recognition in music: sadness ($r = .44$), happiness ($r = .42$), and tenderness ($r = .38$; Vuoskoski & Eerola, 2011). In another study openness to experience was positively linked ($r = .21$) with experienced intensity of emotions in sad music (Vuoskoski et al., 2012).

A modern understanding of musicality is that every individual possesses musical abilities and that these abilities are distributed normally among people (Müllensiefen et al., 2014). Beyond playing an instrument and singing, musicality includes many elements of engaging with music (Müllensiefen et al., 2014; Wesseldijk et al., 2020). According to this view of musicality, musical abilities do not solely originate from musical practice, but can be strengthened through other forms of engagement with music as well (Mosing et al., 2014). For example, early signs (during first year of life) of music appreciation were discussed in a review by (Nieminen et al., 2011) and data from more than a quarter of a million individuals showed that younger people attribute more importance to music and listen to music more often in comparison with older ones (Bonneville-Roussy et al., 2013). However, very limited research is available investigating the links between different aspects of musical sophistication and personality. One exception is the study by Greenberg and colleagues (2015) who used the concept of musical sophistication that included active engagement with music, listening, instrumental and singing abilities, melodic memory, and rhythm perception. The results of this study showed that personality trait facets from the Big Five Inventory predict musical sophistication even after controlling for demographic variables, with openness to aesthetics as the best predictor for general musical sophistication (βs between .32 and .43). Other predictors in the controlled model were the subdimensions of extraversion assertiveness (.07) and activity (.05), the agreeableness facet altruism (.05), neuroticism factor depression (.03), and the openness aspect ideas (−.03). Previous research highlights the importance of music for adolescents' development and its biological, psychological, and social effects, especially the influence of music on many major areas of development like aesthetics, identity, socialization, emotion regulation, coping, motivation, and gender roles (see review by Miranda, 2013). Although longitudinal studies are still missing, researchers like Miranda and colleagues (2010) investigated the relationship between personality meta-traits of the

Five-Factor Model and music preferences in adolescence (age: $M = 16.45$, $SD = 0.81$ years) and argued that music plays an important role in adolescents' development.

Regarding the study of personality development using general personality traits, some previous research argued that all the personality traits show weak to strong intercorrelations, suggesting existence of general personality factors (van der Linden et al., 2010). However, this discussion is still ongoing and thus it is still meaningful to discuss the Big Five traits separately (Van der Linden et al., 2021).

Overall, the available research suggests that engagement with music/personality links may differ for different aspects of engaging with music, including intensive professional training; analytical listening to music; communicating about music; musical preferences and listening behaviors and other music-related activities; and that these links might develop during childhood and adolescence.

The current study

This study explores the links between Big Five personality dimensions and musical sophistication in adolescents. We used a multivariate measure of musical sophistication—the Goldsmiths musical sophistication index (Gold-MSI, Müllensiefen et al., 2014). The Gold-MSI allows to investigate musicality in all people, rather than only in musicians, as in most previous research (e.g., Asztalos & Csapó, 2017; Bentley, 1966; Boyle & Radocy, 1987; Gordon, 1989; Seashore et al., 1960; Wallentin et al., 2010; Wing, 1962). The Gold-MSI self-report inventory targets active musical engagement and expertise in any form and regardless of musical genre (including DJing or music blogging); and does not focus on knowledge about music theory or formal music training.

Previous research has focused mostly on individual personality traits links with specific musical abilities in specific ages and samples. The current study is a comprehensive attempt to answer the following research questions, applying network analysis to the data from three studies, conducted in United Kingdom, Germany, and Russia: (1) Which musical sophistication dimensions are linked to which aspects of personality? (2) Are the observed associations between personality and musical sophistication consistent across different countries and ages?

Study 1—United Kingdom

Method

Participants. 751 pupils (83.8% female, 12.3% male, 1.7% other, 2.3% rather not say, $M_{age} = 14.24$ years, $SD_{age} = 1.60$ years) were recruited from three selective secondary (private or boarding) schools in the United Kingdom (School 1: 43.3%, School 2: 20.8%, and School 3: 36%). All pupils participated voluntarily and consent from their parents was obtained. The study was approved by an ethical committee of the Goldsmiths, University of London. Not all students completed all parts of the assessment, which resulted in a final sample size of $N = 619$.

Procedure. The assessment took place in groups in school computer labs during normal school hours. Participants worked on their individual computer or tablet, wearing headphones. Participants were instructed to work through the online test battery at their own pace. The measures used in this study were part of a bigger test battery that took approximately 90 min.

Measurements. Data from the following two self-report questionnaires were analyzed in this study:

Table 1. Correlation Matrix of the Big Five Personality Traits and the Five Dimensions of Musical Sophistication for the UK Sample.

	Musical sophistication					Big five personality				
	AE	PA	MT	EM	SA	Ope	Con	Ext	Agr	EmS
AE	1									
PA	.48***	1								
MT	.49***	.57***	1							
EM	.52***	.39***	.30***	1						
SA	.48***	.69***	.56***	.32***	1					
Ope	.07	.14***	.09*	.23***	.17***	1				
Con	−.08*	.11**	.07	.10*	.10*	.43***	1			
Ext	−.06	.00	−.07	.06	.02	.35***	.18***	1		
Agr	.02	.06	.02	.11**	.06	.54***	.39***	.25***	1	
EmS	−.12**	−.02	−.05	−.10*	−.03	.36***	.32***	.35***	.35***	1

Note. $N = 619$. Significance level has been adjusted using Bonferroni correction resulting in $\alpha_{adj} = .0011$ (only results with a p-value below this level should be regarded as significant). AE = active engagement; EM = emotions; MT = musical training; PA = perceptual abilities; SA = singing abilities; Ope = openness; Con = conscientiousness; Ext = extraversion; Agr = agreeableness; EmS = emotional stability.
*$p < .05$. **$p < .01$. ***$p < .001$.

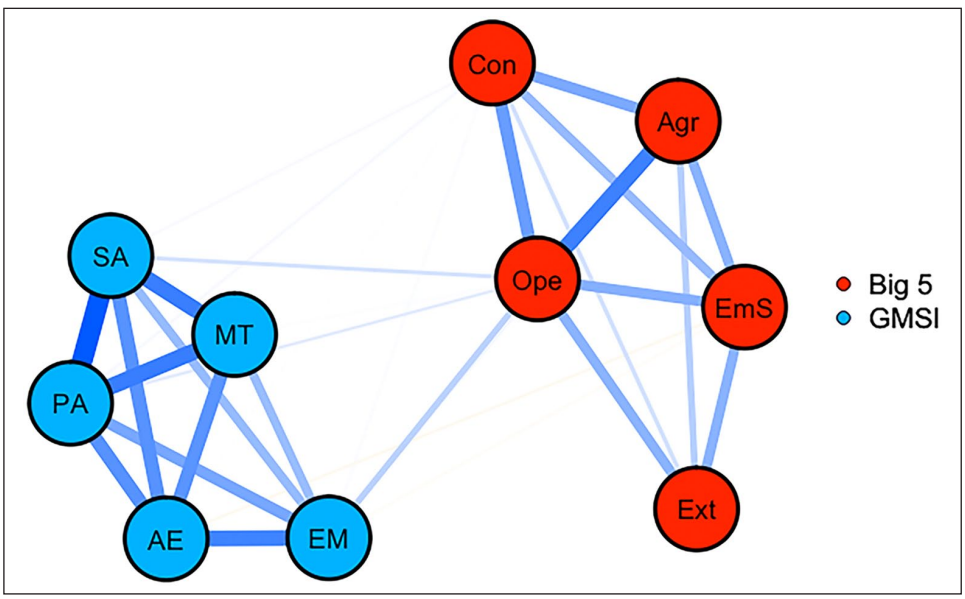

Figure 1. Graphical Network Model of Musical Sophistication and Big Five Personality Traits in the UK Sample.

Ten-Item Personality Inventory (TIPI, Gosling et al., 2003) was used to assess the Big Five personality traits—two items per trait: Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Emotional stability. An adapted version for children from 10 years of age and older was used (Müllensiefen et al., 2015). Participants were asked to indicate on 7-point Likert scales how much they identify with the attributes that describe a trait. The scores for all

personality traits were computed by averaging scores for the two items. All items and descriptive statistics of the TIPI can be found in Table 6 in Appendix.

Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014) was used to assess Musical sophistication on the following five dimensions: Active engagement (nine items); Emotions (six items); Musical training (seven items); Perceptual abilities (nine items); and singing abilities (seven items). The scores for all traits were computed by averaging scores for each measure. The measurement of musical sophistication was validated in several studies (Fiedler & Müllensiefen, 2015; Müllensiefen et al., 2015). Example items for the subscales and their descriptive statistics for all samples can be found in Table 7 in Appendix.

Statistical analysis. Analyses were carried out in R version 3.6.3 using the *psych* and *qgraph* packages.

At first, we provide a correlation matrix for all variables. Then, we compute a network model of the five personality and five musical sophistication factors using the *qgraph* package. A network is an abstract model that displays nodes and their links representing entities and their relations (Costantini et al., 2015; Epskamp et al., 2012; Isvoranu et al., 2022). Here, we present a (partial correlations) network graph of a correlation matrix that addresses the question whether correlations between variables are still meaningful once the influence from other associated variables has been accounted for (partialled out). All edges have certain weights that represent the strength of the connections which makes important structures easier to spot. Network analysis (Isvoranu et al., 2022) has been extensively applied for personality (Costantini et al., 2015; Cramer et al., 2012), psychopathology (Borsboom & Cramer, 2013; Fried et al., 2016; McNally et al., 2015; Robinaugh et al., 2014), and cognitive data (Conte et al., 2020).

Results

Correlations. Table 1 presents correlations for all study variables. As can be seen from Table 1, all personality dimensions were modestly to moderately correlated with each other; all musical sophistication dimensions were also moderately associated with each other; and there were some weak links between personality and musical sophistication.

Network model. The network model (see Figure 1) shows that of all the correlations between personality and musical sophistication, only the openness—emotions link remained significant.

Study 2—Germany

Method

Participants. The 1,114 pupils (47.7% female, 46.8% male, 2.1% other, 3.5% rather not say, $M_{age} = 10.89$ years, $SD_{age} = 0.78$ years) were recruited from seven secondary schools in Germany. Due to time restrictions not all participants finished all parts of the test battery, resulting in a final sample size of $N = 924$. All pupils participated voluntarily and consent from their parents was sought. The study was approved by the ethical committee of the Leibniz University, Hanover, as well as by the Ministries of Culture and Education in Hesse and Baden-Württemberg.

Procedure. The study used the same procedure as Study 1.

Measurements and statistical analysis. The measures were the same as in Study 1. The Big Five personality traits were assessed using a German version of the Ten-Item Personality Inventory

Table 2. Correlation Matrix of the Big Five Personality Traits and the Five Dimensions of Musical Sophistication for the German Sample.

	Musical sophistication					Big Five personality				
	AE	PA	MT	EM	SA	Ope	Con	Ext	Agr	EmS
AE	1									
PA	.46***	1								
MT	.47***	.41***	1							
EM	.58***	.51***	.34***	1						
SA	.57***	.59***	.38***	.48***	1					
Ope	.20***	.27***	.25***	.27***	.22***	1				
Con	.04	.24***	.13***	.14***	.16***	.39***	1			
Ex	.19***	.26***	.17***	.23***	.25***	.36***	.25***	1		
Agr	.07*	.19***	.16***	.17***	.20***	.35***	.39***	.15***	1	
EmS	.04	.19***	.05	.03	.12***	.24***	.23***	.27***	.26***	1

Note. $N = 924$. Significance level has been adjusted using Bonferroni correction resulting in $\alpha_{adj} = .0011$ (only results with a p-value below this level should be regarded as significant). AE = active engagement; PA = perceptual abilities; MT = musical training; EM = emotions; SA = singing abilities; Ope = openness; Con = conscientiousness; Ext = extraversion; Agr = agreeableness; EmS = emotional stability.
*$p < .05$. **$p < .01$. ***$p < .001$.

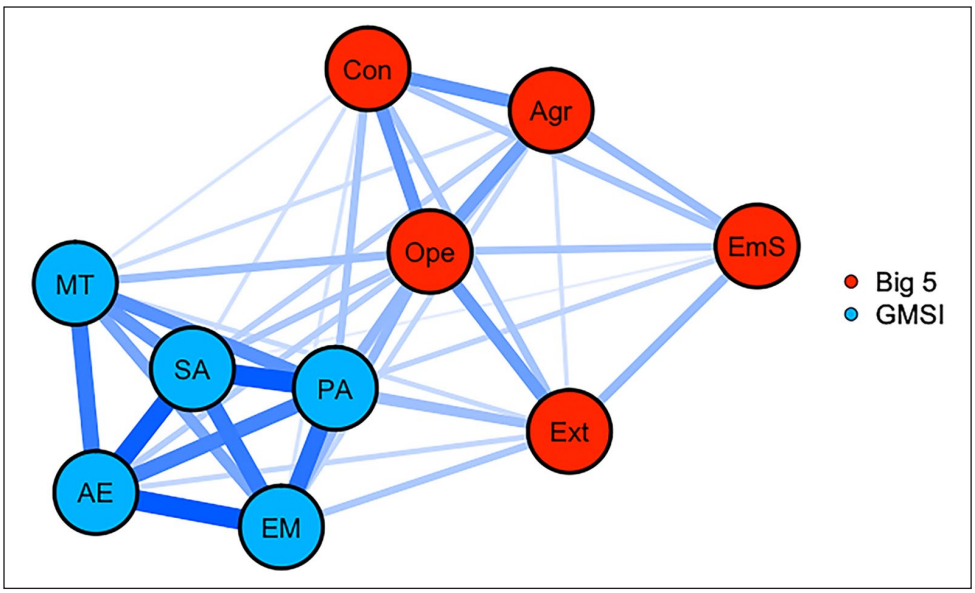

Figure 2. Graphical Network Model of Musical Sophistication and Big Five Personality Traits in the German Sample.

(TIPI, Gosling et al., 2003) that was adapted like described in Study 1. The items and descriptive statistics of the TIPI for this sample can be found in Table 6 in Appendix.

Musical sophistication was assessed using a German version of Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014). Descriptive statistics can be found in Table 7.

The same analyses as in Study 1 were performed, using the same software packages.

Results

Correlations. Table 2 provides correlations for all study variables. As can be seen from Table 2, all personality dimensions were modestly to moderately correlated with each other; all musical sophistication dimensions were also moderately associated with each other; and most personality-musical sophistication links were significant.

Network model. The network model (see Figure 2) shows more partial correlations between musical sophistication and personality, compared with Study 1. Openness and extraversion showed the strongest associations with aspects of musical sophistication, especially with active engagement with music, perceptual abilities, and the emotions aspect of musical sophistication as can be seen in Figure 2 (the thickest lines indicating the strongest links).

Study 3—Russia

Method

Participants. The sample included 346 adolescents (39.8% female, 57.2% male, 2.8% rather not say, M_{age} = 15.22 years, SD_{age} = 1.03 years) out of those 318 finished all relevant tests. The participants were recruited at an educational center in Russia that provides intensive programs for adolescents with high achievement in science, sports or arts (Likhanov et al., 2020; Papageorgiou et al., 2020). The study was approved by the Ethics Committee for Interdisciplinary Investigations, Tomsk State University. Participants' assent and their parents' or guardians' written informed consents were obtained prior to the testing session.

Procedure. Procedure was the same as in Study 1 and Study 2.

Table 3. Correlation Matrix of the Big Five Personality Traits and the Five Dimensions of Musical Sophistication for the Russian Sample.

	Musical sophistication					Big Five personality				
	AE	PA	MT	EM	SA	Ope	Con	Ext	Agr	EmS
AE	1									
PA	.43***	1								
MT	.46***	.36***	1							
EM	.66***	.57***	.30***	1						
SA	.57***	.64***	.32***	.53***	1					
Ope	.47***	.31***	.22***	.49***	.38***	1				
Con	.08	.04	−.11*	.09	.15**	.28***	1			
Ex	.15**	.11*	.01	.16**	.27***	.41***	.32***	1		
Agr	−.01	−.01	−.05	.09	.06	.19***	.19***	.24***	1	
EmS	−.21***	−.03	−.10	−.18**	.00	.05	.27***	.42***	.22***	1

Note. N = 318. Significance level has been adjusted using Bonferroni correction resulting in α_{adj} = .0011 (only results with a p-value below this level should be regarded as significant); AE = active engagement; PA = perceptual abilities; MT = musical training; EM = emotions; SA = singing abilities; Ope = openness; Con = conscientiousness; Ext = extraversion; Agr = agreeableness; EmS = emotional stability.
*p < .05. **p < .01. ***p < .001.

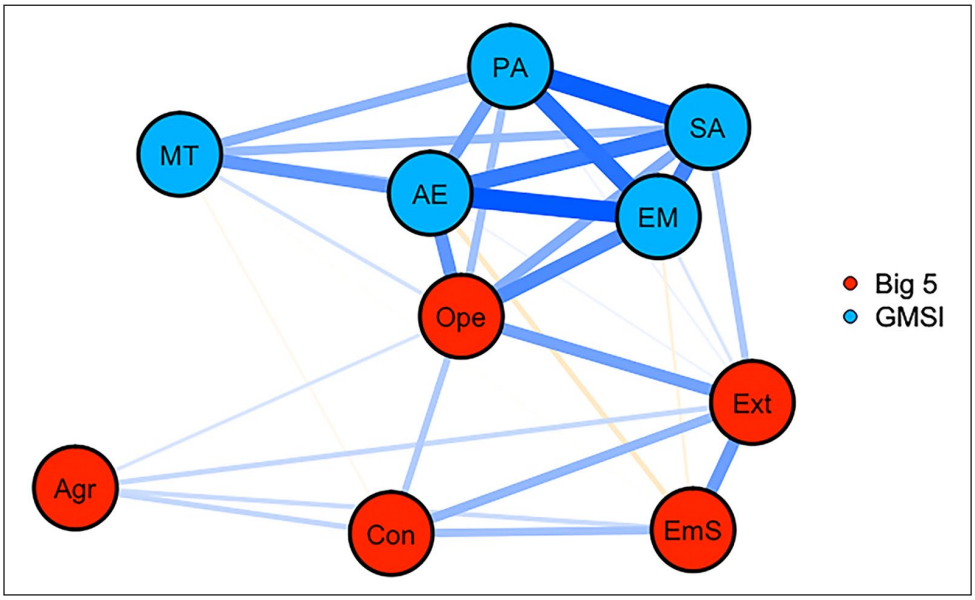

Figure 3. Graphical Network Model of Musical Sophistication and Big Five Personality Traits in the Russian Sample.

Measurements and statistical analysis. The Big Five personality traits were assessed using a 44-item Big Five Inventory (John et al., 2008). The Russian version from Mishkevich (2016) was used in the current study. Participants indicated whether specific statement applied to them on a Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Neuroticism was reverse coded and is referred to as emotional stability to match Study 1 and Study 2. Total scores were computed by averaging item scores for each scale (see Table 6).

Musical sophistication was measured using the Russian adaptation of the Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014). The questionnaire was translated to Russian and back translated to English by two independent translators for whom Russian is the first language and English is the second language following the ITC guidelines for test translations (International Test Commission, 2017). Due to a technical error, one of the active engagement items consists of six instead of seven response options (see descriptive statistics in Table 7).

The same analyses as in Study 1 and Study 2 were performed, using the same software packages.

Results

Correlations. Table 3 presents correlations for all study variables. As can be seen from Table 3, all personality dimensions were weakly to moderately correlated with each other; all musical sophistication dimensions were moderately associated with each other; and there were some weak links between personality and musical sophistication.

Network model. The network model (see Figure 3) shows associations between openness and four of the musical sophistication dimensions: active engagement, singing ability, musical training and emotions with active engagement, and emotions being the strongest associations as indicated by the thickest edges in Figure 3. Weaker links were found between extraversion—

singing ability, emotions, perceptual ability, and active engagement as well as between emotional stability—active engagement and emotions.

Meta-analyses and model comparisons

Here, we present aggregated results and comparisons for the three studies to explore where we find consistencies or differences across the three samples. Table 4 summarizes the sociodemographic information of the three studies.

Comparison of the network models

First, we compared the differences of the networks across the three samples. The Network Comparison Test from the *NetworkComparisonTest* package (NCT; van Borkulo, 2016) uses a permutation approach to test for differences between networks (see Figures 1–3). In terms of structure, the maximum absolute difference between two corresponding edges (M) is used which means that a specific edge is picked after permutation and then compared across samples. The absolute difference indicates whether this specific edge has the same strength in all samples. A second comparison tests the global strength of the networks, indicated by the overall strength of connectivity which is defined as the weighted absolute sum of all edges in a network (S; van Borkulo et al., 2017). We performed three pairwise comparisons.

As shown in Table 5, in terms of absolute strengths (M) UK sample differs significantly from the Russian and German samples. In terms of global strength (S) Russian sample significantly differs from the UK sample. The absolute M values indicate that the three networks differ in their structure, while the S value shows that the strength of correlations between individual variables not always differs significantly. Thus, the networks are not identical, but the variables have predominantly comparable connections (except in comparison of the UK and Russian sample) which we investigate with the following meta-analysis.

Table 4. Descriptive Statistics of the Sociodemographic Variables of the Three Samples.

Sample	N	M_{age}	SD_{age}	$\text{Gender}_{\text{female}}$	Education background
UK	751	14.24	1.60	83.8%	Mainly students from selective private schools
Germany	1,114	10.89	0.78	47.7%	Mainly students from non-selective public schools
Russia	346	15.22	1.03	39.8%	Students with high achievement in different areas

Table 5. Network Comparison Test for the Network Models of the Three Samples.

	M	p	S	p
United Kingdom				
Germany	.195	$<.001$	.268	.37
Russia	.349	.02	.386	.04
Germany				
Russia	.274	.06	.118	.48

Note. M = Test statistic M of the network invariance test, S = Test statistic S of the global strength invariance test.

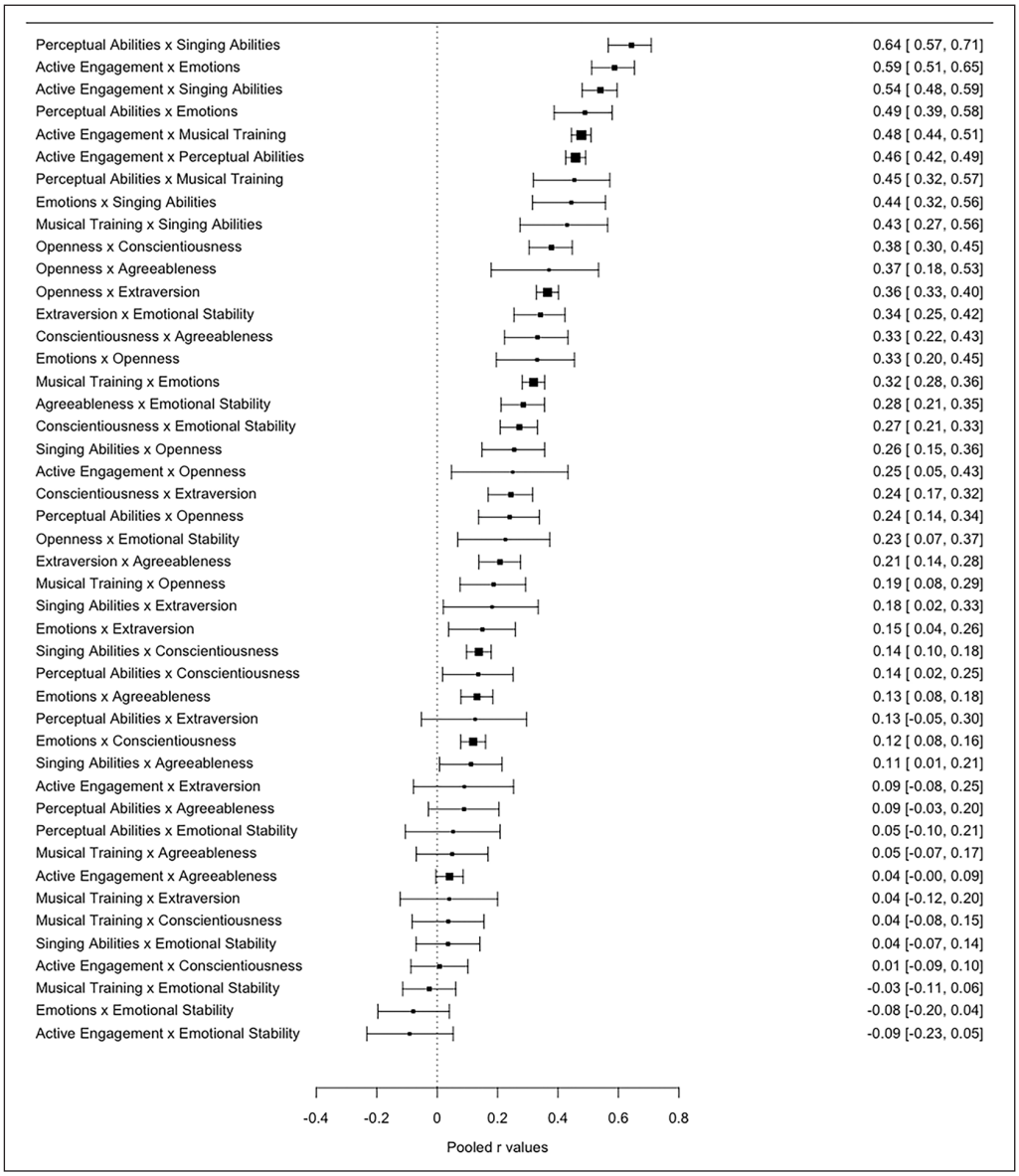

Figure 4. Forest Plot of the Pooled Correlations With 95% Confidence Intervals Between Musical Sophistication and Big Five Personality Traits.

Aggregated correlations

Next, a meta-analysis using random effect models (R package *meta*) was computed to check the consistency and magnitude of correlations across the three samples. Figure 4 shows the pooled correlations $\bar{r}$ for every possible association. 32 out of the 45 correlations were significant in all samples, that is, the 95% confidence intervals did not include zero (detailed statistics can be found in Table 8 in the Appendix).

Discussion

The aim of this study was to investigate associations between personality traits and musical sophistication. The study utilized a statistical approach that allows to explore more meaningful links in cross-sectional data than traditional correlations, that is, network analysis. We found complex links between personality and musical sophistication in young populations across samples from three countries.

The only consistent (present in all three samples) links were shown between openness and four musical sophistication factors: emotions, singing abilities, musical training, and perceptual abilities. The aggregated correlations of the meta-analysis indicate that all these four links have small to medium effect sizes ($\overline{r}$ between .19 and .33). This result suggests that people who report to be able to understand emotions in music and express emotions through music are on average more open to experiences; and vice versa. The strongest association between emotions in music and openness is not surprising since interest in art and culture is associated with greater openness (Butkovic et al., 2015; Goldberg, 1990). For example, individuals high on openness have been found to be more imaginative and sensitive to art (Costa & McCrae, 1992). The network analyses help us identify central nodes of the correlational networks. In this case, openness shows high centrality tendencies, which is in line with previous research, but also conscientiousness and extraversion seem to be relevant nodes that should be investigated further. The network comparisons in turn indicate that there are cultural differences between the samples as they are not identical which should be considered in future research.

The links between emotions and openness may be partly explained by other factors. For example, openness was shown to be related to intelligence (Major et al., 2014; Papageorgiou et al., 2020). Measures of musical sophistication may also capture intelligence to some extent. For example, the emotions dimension of musical sophistication included items that require participants to identify and interpret their music-related emotions—which require cognitive processing. Moreover, there is evidence that musical training affects intelligence with small effect (see meta-analysis by Sala & Gobet, 2017) and has a positive impact on academic achievement (Guhn et al., 2019; Yang et al., 2014) which makes musical engagement an important matter for educators. Additionally, musical sophistication can be caused by cultural and social influences and in turn might influence musical identities (MacDonald et al., 2002) and musical preferences which could contribute to personality. However, the direction of the links is unclear. Further research is needed to establish these links using methods such as experimental and longitudinal design or novel analytical techniques such as causal modeling. Other analytical techniques might include structural equation modeling, regression trees, and random forest models. These techniques were, for example, applied to predict individuals' personality from musical preferences (Ruth & Müllensiefen, 2020). Also, our findings in adolescent samples are especially interesting considering the recent paper from Ruth and Müllensiefen (2021), that showed that adolescents tend to drop out of their musical activities at the age of 17 years. Such research that describes links between personality and musical sophistication might shed light on the musical engagement of individuals of this age.

Beyond causal pathways among the variables, many links are likely to be explained by more general processes (Mosing et al., 2014). Much research has suggested that most complex traits, including personality and musical engagement, develop through a complex gene-environment interplay unraveling overtime (Mosing et al., 2014; Polderman et al., 2015; Seesjärvi et al., 2016). Research suggests that many cognitive, personality, and emotional traits have partially overlapping etiology: same genetic and environmental factors contribute to the development of different traits (Rimfeld et al., 2016).

This study used data from three diverse adolescent samples from different countries, with different selection criteria and different age ranges. The results suggested some invariant associations, as

well as sample-specific ones. For example, a negative correlation between active engagement in music and emotional stability was observed in the UK and Russian samples but not in the German one. The divergence of the results with regards to this correlation may be due to smaller age range and the lower mean age of students in the German sample, which limits the amount of variance of emotional stability. Research has shown that this variability increases with age may be explained by hormonal changes in puberty (Canals et al., 2005), as well as in lifestyle changes over the early teenage years. These changes may affect both music engagement and emotional stability.

Limitations and differences in samples

First, the measurements of personality vary between the three samples. While the UK and German sample used the TIPI (Gosling et al., 2003), the Russian sample applied the Big Five Inventory (BFI) questionnaire (John et al., 2008). Although this might lead to some differences, the constructs are conceptually comparable. Previous research suggested that TIPI and BFI (10 vs. 44 items) yield comparable results (Gosling et al., 2003).

Second, there might be problems with comprehension and acquiescence of Big Five questionnaires in children (Soto et al., 2008). Although personality assessment in youth is complicated (Shiner et al., 2021), this study used well-validated measures, previously adapted for the ages of the samples. However, it is not clear if children fully understand the meaning of the items or can articulate how they feel about their personality. According to the disruption hypothesis, personality characteristics might still be unstable at this age (Soto & Tackett, 2015). The three samples used in this study would have been differentially affected by this, with the youngest sample from Germany potentially producing less valid estimates of personality.

Third, using self-report questionnaires to measure musicality always comes with some bias. People may overestimate their musical engagement; or may not understand some specific questions about music. The Goldsmiths musical sophistication index (Müllensiefen et al., 2015) tries to overcome this by not using questions that rely on musical knowledge. But future studies are needed that will supplement questionnaires with tests of musical sophistication (Müllensiefen, 2019), such as the musical emotion discrimination task (MacGregor & Müllensiefen, 2019) or the mistuning perception task (Larrouy-Maestri et al., 2019).

Finally, we acknowledge that the three samples have distinct cultural and sociodemographic backgrounds, which complicates the cross-samples differences. Moreover, the three samples differed in sample size: the German sample was the largest and most representative, as it came from mostly unselected schools. This might have caused more associations in this sample.

Conclusion

Personality and musical sophistication are correlated in adolescents. However, many factors seem to influence these associations. Our data from three countries showed that openness to experience is consistently linked to emotions, singing abilities, musical training, and perceptual abilities. Further research in other cultural contexts is needed to pinpoint universal links like this between personality and musical sophistication. More research, especially longitudinal, is needed investigating the directions, potential mediators, and moderators of the links between musical sophistication and personality.

Authors' Note

Nicolas Ruth is also affiliated to Insitute for Cultural Management and Media, University of Music and Theatre Munich, Munich, Germany.

Elina Tsigeman and Maxim Likhanov are also affiliated to Laboratory for Social & Cognitive Informatics, National Research University Higher School of Economics, Russia.

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ORCID iD


Nicolas Ruth https://orcid.org/0000-0002-4189-3162

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Appendix

Table 6. Descriptive Statistics for the Ten-Item Personality Inventory (TIPI; Gosling et al., 2003) and the Big Five Inventory (John et al., 2008) for All Three Studies.

TIPI						BFI	
Personality trait	Item (I see myself as . . .)	M_{UK}	SD_{UK}	M_{DE}	SD_{DE}	M_{RU}	SD_{RU}
Openness	open to new experiences, complex + *curious, thoughtful* conventional, uncreative + *shallow, simple*	5.17	1.12	5.07	1.12	3.61	0.70
Conscientiousness	dependable, self-disciplined + *responsible, persistent* disorganized, careless + *lazy, irresponsible*	4.8	1.26	4.98	1.12	3.26	0.69
Extraversion	extraverted, enthusiastic + *sociable, lively* reserved, quiet + *shy, private*	4.69	1.5	4.71	1.28	3.14	0.87
Agreeableness	sympathetic, warm + *kind, patient* critical, quarrelsome + *grumpy, selfish*	5.09	1.19	5.11	1.1	3.44	0.64
Emotional stability	anxious, easily upset + *touchy, fearful* calm, emotionally stable + *independent, peaceful*	4.61	1.33	4.72	1.1	2.95	0.89

Note. N_{UK} = 751, N_{DE} = 1114, all items were measured on 7-point Likert scales, ranging from 1 (*disagree strongly*) to 7 (*agree strongly*), adjectives in italic were added to the original scale. N_{RU} = 346, all items were measured on 5-point Likert scales, ranging from 1 (*disagree strongly*) to 5 (*agree strongly*). TIPI = Ten-Item Personality Inventory.

Table 7. Subdimensions of the Goldsmiths Musical Sophistication Index (Müllensiefen et al., 2014) and Descriptive Statistics for All Three Studies.

Dimension	Example item	M_{UK}	SD_{UK}	M_{DE}	SD_{DE}	M_{RU}	SD_{RU}
Active engagement	I spend a lot of my free time doing music-related activities.	3.90	1.02	3.53	0.78	3.28	1.16
Emotions	I sometimes choose music that can trigger shivers down my spine.	4.84	0.97	4.28	0.99	5.06	1.20
Musical training	I would not consider myself a musician.	3.27	1.21	3.22	1.19	2.66	1.37
Perceptual abilities	I am able to judge whether someone is a good singer or not.	4.61	0.98	4.55	0.88	4.73	0.97
Singing abilities	I am able to hit the right notes when I sing along with a recording.	4.17	1.20	4.22	1.06	4.09	1.24

Note. N_{UK} = 751, N_{DE} = 1,114, N_{RU} = 346, all items were measured and weighted as suggested by Müllensiefen and colleagues and range from 1 (*low*) to 7 (*high*).

Table 8. Meta-Analysis of the Correlations Between Musical Sophistication and Personality for the Three Samples (United Kingdom, Germany, and Russia) Using Random Effects Models.

	r_{UK}	r_{DE}	r_{RU}	$\bar{r}$	z	p	LCI (95%)	UCI (95%)
AE × PA	0.476	0.455	0.429	0.458	23.24	<.0001	0.425	0.491
AE × MT	0.489	0.473	0.463	0.477	24.36	<.0001	0.444	0.509
AE × EM	0.519	0.582	0.6631	0.587	12.20	<.0001	0.511	0.653
AE × SA	0.484	0.569	0.569	0.54	14.52	<.0001	0.48	0.595
AE × Ope	0.068	0.2	0.467	0.25	2.4	.016	0.047	0.433
AE × Con	–0.084	0.042	0.075	0.008	0.16	.872	–0.087	0.102
AE × Ext	–0.063	0.186	0.148	0.09	1.05	.293	–0.078	0.253
AE × Agr	0.022	0.073	–0.009	0.041	1.80	.073	–0.004	0.086
AE × EmS	–0.0118	0.041	–0.208	–0.091	–1.24	.216	–0.232	0.053
PA × MT	0.571	0.413	0.356	0.454	6.02	<.0001	0.318	0.571
PA × EM	0.388	0.508	0.57	0.489	8.3	<.0001	0.387	0.579
PA × SA	0.694	0.587	0.644	0.643	12.37	<.0001	0.5662	0.708
PA × Ope	0.14	0.275	0.312	0.24	4.49	<.0001	0.137	0.338
PA × Con	0.106	0.239	0.045	0.136	2.26	.024	0.0183	0.251
PA × Ext	–0.001	0.262	0.108	0.126	1.39	.165	–0.052	0.296
PA × Agr	0.063	0.193	–0.009	0.089	1.47	.14	–0.029	0.204
PA × EmS	–0.019	0.193	–0.028	0.053	0.65	.514	–0.105	0.208
MT × EM	0.303	0.335	0.298	0.319	15.48	<.0001	0.281	0.356
MT × SA	0.565	0.384	0.319	0.43	5.04	<.0001	0.274	0.564
MT × Ope	0.09	0.254	0.215	0.187	3.28	.001	0.076	0.293
MT × Con	0.073	0.125	–0.111	0.037	0.6	.551	–0.083	0.155
MT × Ext	–0.068	0.171	0.011	0.04	0.48	.629	–0.122	0.2
MT × Agr	0.025	0.156	–0.049	0.05	0.82	.412	–0.0694	0.168
MT × EmS	–0.054	0.05	–0.096	–0.026	–0.58	.561	–0.114	0.062
EM × SA	0.315	0.483	0.528	0.444	6.17	<.0001	0.315	0.557
EM × Ope	0.235	0.271	0.488	0.331	4.62	<.0001	0.196	0.454
EM × Con	0.096	0.145	0.089	0.119	5.63	<.0001	0.078	0.16
EM × Ext	0.06	0.228	0.157	0.15	2.61	.009	0.038	0.259
EM × Agr	0.106	0.172	0.087	0.132	4.83	<.0001	0.079	0.184
EM × EmS	–0.101	0.027	–0.179	–0.079	–1.31	.191	–0.196	0.04
SA × Ope	0.171	0.225	0.383	0.255	4.58	<.0001	0.148	0.356
SA × Con	0.103	0.157	0.151	0.138	6.51	<.0001	0.097	0.179
SA × Ext	0.023	0.247	0.275	0.182	2.2	.0277	0.02	0.334
SA × Agr	0.063	0.201	0.058	0.112	2.12	.034	0.008	0.214
SA × EmS	–0.027	0.125	–0.001	0.036	0.66	.508	–0.07	0.141
Ope × Con	0.434	0.388	0.284	0.378	9.37	<.0001	0.304	0.447
Ope × Ext	0.351	0.36	0.413	0.365	11.97	<.0001	0.328	0.401
Ope × Agr	0.535	0.351	0.19	0.37	3.66	.0002	0.179	0.534
Ope × EmS	0.365	0.244	0.045	0.226	2.78	.005	0.068	0.373
Con × Ext	0.176	0.249	0.324	0.244	6.21	<.0001	0.169	0.316
Con × Agr	0.389	0.392	0.186	0.332	5.69	<.0001	0.223	0.433
Con × EmS	0.323	0.23	0.265	0.272	8.2	<.0001	0.209	0.332

(Continued)

Table 8. (Continued)

	r_{UK}	r_{DE}	r_{RU}	$\bar{r}$	z	p	LCI (95%)	UCI (95%)
Ext × Agr	0.246	0.151	0.243	0.208	5.76	<.0001	0.138	0.276
Ext × EmS	0.353	0.267	0.42	0.342	7.28	<.0001	0.254	0.423
Agr × EmS	0.352	0.262	0.224	0.285	7.31	<.0001	0.211	0.355

Note. AE = active engagement (from the Goldsmiths Musical Sophistication Index, GMSI); Agr = agreeableness; Con = conscientiousness; EM = emotions (GMSI); EmS = emotional stability; Ext = extraversion; LCI = lower confidence interval; Ope = openness; UCI = upper confidence interval; MT = musical training (GMSI); PA = perceptual abilities (GMSI); SA = singing abilities (GMSI).