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Intelligence, Music Preferences, and Uses of Music From the Perspective of Evolutionary Psychology

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Music is a component of human culture of a historically universal presence. Enjoyed by many and irrelevant to few, music continuously receives interest from academia and the public alike. Capable of uniting, as well as dividing, music is often in a focus of individual comparisons. In this study, we combine the approaches of evolutionary and social psychology to investigate the relationship between intelligence, music preferences, and uses of music. We collected data from 467 high school students. We used the Nonverbal Sequence Test, the Uses of Music Questionnaire, and the Scale of Music Preferences. Confirming our expectations based on the Savanna-IQ interaction hypothesis, we found intelligence to be a significant predictor of the preference for instrumental music, but not of the preference for vocal-instrumental music. Furthermore, we revealed the significant role of cognitive use of music as a predictor of the preference for instrumental music. We conducted factor analysis of the Scale of Music Preferences, and revealed five factors: reflective, popular, conservative, intense, and sophisticated. We also found the cognitive use of music to be significantly correlated with the preference for instrumental music, as well as music of reflexive, intense and sophisticated factors. Taken together, our findings support the Savanna-IQ interaction hypothesis.

Keywords: cognition, evolution, language, music, Savanna-IQ Interaction Hypothesis

Music is a cultural phenomenon that has been present in all known human cultures throughout their history. Most members of the *Homo sapiens* species are able to perceive music, its tones, timbre, pitch, intervals, melodic contours, rhythm and harmony (Sacks, 2008). When it comes to songs, almost every human can both identify and reproduce a large number of them (Miller, 2000). Because of music's universality, Darwin assumed that the way humans perceive music roots to a common precursor music shared with language—the *musilanguage*, or a musical protolanguage (Brown, 2000). According to this hypothesis, musilanguage evolved into two separate systems with two distinct purposes. One of them is language, and its purpose is communicating information. The other one is music, the purpose of which is communicating emotions. Neither of the two purposes, however, are limited: Perception of music may involve complex cognitive processing, whereas emotions can also be transmitted through paralinguistic and prosodic aspects of speech (Fitch, 2006).

One of the most intriguing questions in the music research is the question of music preferences. Most people, including the ones who claim to be "tone deaf" are capable of differentiating between the music they enjoy and the music they can barely tolerate (Hargreaves, Miell, & Macdonald, 2002). This is not surprising, as numerous researchers have established

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that music preferences are often a very important part of a person's identity. Music preferences were also found to be correlated with a number of variables, some of which include gender; personality traits; conformity; life satisfaction; the need for relatedness; and the importance of religion, music, and nationality in a person's life (Butkovic, Vukasovic, & Bratko, 2011), the way people experience emotions, emotional stability, empathy (Vuoskoski, Thompson, McIlwain, & Eerola, 2012), and intelligence (Kanazawa & Perina, 2012).

The relationship between music preferences and intelligence first gained researchers' attention in the context of Gardner's (1983) intelligence theory. Among the eight mutually independent types of intelligence he proposed, musical intelligence found its place, as a reference to people's differing sensitivity to various musical properties (such as pitch, tone, and rhythm), and the ability to perceive and appreciate them. Individual differences have also been revealed in auditory processing (Ga), one of the cognitive abilities suggested within the Cattel-Horn-Carroll (CHC) model of cognitive abilities (McGrew, 2009) - the cognitive ability theory most supported by empirical evidence (Kaufman, 2009). Auditory abilities proposed by the CHC model include the ability to analyze, synthesize and discriminate auditory stimuli (Flanagan, Ortiz, & Alfonso, 2013). It has also been hypothesized that musical training enhances intelligence (Schellenberg, 2004), although the effects of voice and keyboard musical training have so far proven to be relatively small. Finally, the intelligence-music relationship has also gained attention within the discipline of evolutionary psychology.

An interesting contribution to the research of music preferences comes from Kanazawa's (2010a) Savanna-IQ interaction hypothesis. On the basis of the Savanna principle, this hypothesis rests on a consensus among the majority of evolutionary biologists that the human brain has not experienced significant changes since the Pleistocene. The reason for this is attributed to the insufficient stability of the human environment (Kanazawa & Perina, 2009). According to the Savanna principle, modern humans' environment consists of two types of stimuli: the evolutionarily familiar—the stimuli that have been present in the environment of evolutionary adaptedness (EEA) and the evolutionarily novel—the stimuli that have not been present in the EEA. While the former were omnipresent and comprised situations that were encountered by our ancestors on regular basis (e.g., food or mate selection), the latter occurred more sporadically. The individuals who were endowed with an early version of what we now consider to be general intelligence are hypothesized to have been better at understanding such situations and dealing with them (Kanazawa, 2004). Kanazawa's Savanna-IQ interaction hypothesis proposes that general intelligence evolved as a module of the brain, which is in charge of dealing with such nonrecurring problems. The individuals with higher general intelligence should therefore be better able to do so. Furthermore, since there is a higher chance that a person will prefer stimuli they understand over those they do not understand, it is hypothesized that intelligence will affect people's preference as well. If true, this will be reflected in a higher likelihood of preference for the evolutionary novel stimuli among people with higher scores on intelligence tests. Previous research has confirmed the relationship between intelligence and substance use (Kanazawa & Hellberg, 2010), liberal political views and atheism (Kanazawa, 2010b), circadian rhythms (Kanazawa & Perina, 2009), homosexuality (Kanazawa, 2012), childlessness (Kanazawa, 2014), enjoyment of TV programs (Kanazawa, 2006b), health (Kanazawa, 2008), wealth of states (Kanazawa, 2006a), and music preferences (Kanazawa & Perina, 2012).

If the evolution of music has started with music being a part of musilanguage, its original form would have been vocal (Brown, 2000). Vocal music would, therefore, be evolutionarily familiar, while instrumental music could be considered evolutionarily novel. The hypothesis that follows is that individual differences in the preference for instrumental music are to be expected with regard to intelligence test scores, whereas no such relationship should be observed in the case of the preference for vocal music. This was confirmed by Kanazawa and Perina (2012). Dividing music styles into mostly instrumental and mostly vocal-instrumental, the findings of this research suggest that people with higher intelligence test scores have a higher preference for instrumental music styles, while no such difference was found in the case of the preference for mostly vocal-instrumental music.

Rentfrow and Gosling (2003) obtained an interesting, but somewhat differing result. Their study revealed a positive correlation between higher intelligence test scores and a preference for reflective and complex music styles and intense and rebellious music styles. Additionally, participants with lower intelligence test scores preferred upbeat and conventional music styles. Because predictiveness of intelligence test scores was not limited to instrumental music styles, these results are not in complete accordance with the Savanna-IQ interaction hypothesis. However, the results may have been mediated by the differences in participants' uses of music.

Music can play many different roles in people's lives, and Chamorro-Premuzic and Furnham (2007) identified three broad uses of music: emotional use (associated with manipulation or regulation of emotions), cognitive use (rational appreciation of music), and background use (music used as background to other activities). If we assume that the musilanguage hypothesis is correct and that music evolved as a way to communicate our emotions, the evolutionarily familiar use of music would be the emotional use. Following the same reasoning, the cognitive use of music would be evolutionarily novel. In this study, we test these assumptions. Following the research of Kanazawa and Perina replicated in this study, we propose that general intelligence will be a significant predictor of a higher preference for instrumental music, but the same will not be the case for a preference for vocal-instrumental music. In addition, we expect that cognitive use of music will have a significant positive relationship with a preference for instrumental music. Finally, we hypothesize that a preference for reflective, complex and intense music styles will be correlated to the cognitive use of music, and because of this, also to a higher intelligence.

Method

Participants and Procedure

The data were collected from 480 Croatian high school students (53.7% women). Their age ranged between 16 and 19 years ($M = 16.83$, $SD = 0.484$). Data collection took place in a group setting, during school hours. The participants were heterogeneous in respect to their socioeconomic status, and their parents' degrees of education (see Table 1), as well as their music education. A third of our sample (34.6%) reported having received music education outside of the regular school program. Among these students, 2.5% were self-taught, 6.4% had taken private lessons, 10.2% had taken a music courses, and 15.6% had attended music schools. Students' music education ranged between 1 month and 13 years, with a mean of 16.2 months ($SD = 29.2$, $N = 478$).

Instruments

We measured general intelligence via the Nonverbal Sequence Test (NST; Ljubotina, 2017). The rationale of the test strongly resembles that of Raven's Progressive Matrices (Raven, Raven, & Court, 2003), with abstract stimuli sequences used instead of matrices. Test consists of 43 items, for which the solving time is limited to 35 min. The reliability was $\alpha = .83$.

To measure participants' music preferences, we designed the Scale of Music Preferences. It

Table 1
Family Monthly Income and Parents' Degrees of Education (N = 467)

Monthly income		Parents' degrees of education	Mother	Father
0–3,000 HRK	3.0%	Elementary school	4.4%	1.3%
3,000 – 6,000 HRK	12.9%	High school	45.5%	51.5%
6,000 – 9,000 HRK	28.0%	College	17.8%	15.0%
9,000 – 12,000 HRK	25.0%	University degree	26.4%	23.4%
12,000 – 15,000 HRK	14.4%	Postgraduate degree	5.9%	8.9%
15,000 – 18,000 HRK	6.2%			
Over 18,000 HRK	10.1%			

Note. HRK—Croatian currency—kuna; 1 HRK = .15 US Dollar.

comprised 20 music styles, which we listed in an alphabetical order to avoid our scale conveying any kind of implicit ranking. We accompanied the name of each music style with a couple of representatives, so as to ensure that participants knew to what type of music we referred. We made a clear remark that participants' task was not to assess their preference for the artists listed as examples, but for each music style as a whole. Similar to the original research by Kanazawa and Perina (2012), we defined three of the styles as mostly instrumental (ambient/New Age/chill out, big band, classic instrumental music), and the rest as mostly vocal-instrumental (blues, jazz, reggae/ska/dub, pop, r-n-b, Latin, folk, patriotic, commercial, turbofolk, spiritual/religious, metal, punk, rock, electronic/dance, opera, rap/hip hop). Participants rated their preference for each music style on a five-point Likert scale (with 5 indicating the strongest preference, and 1 indicating the lowest). We calculated the preferences for instrumental and vocal-instrumental music as means of preferences for styles defined as mostly instrumental or mostly vocal-instrumental.

To examine participants' uses of music, we applied the Uses of Music Inventory (Chamorro-Premuzic & Furnham, 2007). Comprising 15 items, this instrument provides a measure of three distinct uses of music: emotional, cognitive and background (see Table 2). Cronbach's alpha reliability estimates for the three five-item subscales were somewhat lower than in the original study and ranged between 0.6 and 0.7, but such reliability values are not uncommon for short instruments. The items were evaluated on a five-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

In addition, the participants filled out a short demographic questionnaire, which inquired about their age, gender, their family's monthly income, parents' degrees of education, and duration and type of their music education. We analyzed all data in SPSS v.17.0 (SPSS, 2008).

Results and Discussion

Predicting the Preferences for Instrumental and Vocal-Instrumental Music

We found a significant positive correlation between the score on the general intelligence test (from here on referred to as *general intelligence*) and the preference for instrumental music ($r = .246$, $p < .01$, $N = 448$). Unexpectedly, we also revealed a significant positive relationship between general intelligence and the preference for vocal-instrumental music ($r = .103$, $p < .05$, $N = 420$). Although the former confirmed our hypothesis and is in accordance with the results of Kanazawa and Perina (2012), the latter was unanticipated. However, the correlation between general intelligence and the preference for vocal-instrumental music that we report is of a significantly lower value than the correlation between general intelligence and the

Table 2
Uses of Music Inventory (Chamorro-Premuzic & Furnham, 2007)

No.	Item	Use of music
1	Listening to music really affects my mood.	Emotional
2	I am not very nostalgic when I listen to old songs I used to listen to (R).	Emotional
3	Whenever I want to feel happy I listen to a happy song.	Emotional
4	When I listen to sad songs I feel very emotional.	Emotional
5	Almost every memory I have is associated with a particular song.	Emotional
6	I often enjoy analyzing complex musical compositions.	Cognitive
7	I seldom like a song unless I admire the technique of the musicians.	Cognitive
8	I don't enjoy listening to pop music because it's very primitive.	Cognitive
9	Rather than relaxing, when I listen to music I like to concentrate on it.	Cognitive
10	Listening to music is an intellectual experience for me.	Cognitive
11	I enjoy listening to music while I work.	Background
12	Music is very distracting so whenever I study I need to have silence (R).	Background
13	If I don't listen to music while I'm doing something, I often get bored.	Background
14	I enjoy listening to music in social events.	Background
15	I often feel very lonely if I don't listen to music.	Background

Note. (R) - item re-coded prior to analysis.

preference for instrumental music ($z = 2.17$, $p = .015$). We therefore believe that both of these findings offer support for the Savanna-IQ interaction hypothesis (Kanazawa & Hellberg, 2010).

Participants with higher general intelligence were not more likely to use music cognitively ($r = -0.21$, $p = .659$, $N = 454$). The Savanna-IQ interaction hypothesis only predicts differences in evolutionarily novel stimuli, and if music evolved as a part of musilanguage (Brown, 2000), the transmission of emotions would be its evolutionary familiar use, while the cognitive use could be considered an evolutionary novel one (Kanazawa & Perina, 2012). If this is the case, there should be no differences in emotional use of music among individuals in respect to their intelligence. Our results support this hypothesis, as those of our participants with higher general intelligence were not more (or less) likely to use music emotionally ($r = -0.078$, $p = .101$, $N = 447$) or as a background to their other activities($r = -0.013$, $p = .790$, $N = 447$).

Kanazawa and Perina (2012) pointed out a potential problem with inspecting the correlation between intelligence and preferences for specific music styles in that the preferences for all of them tend to be highly correlated, suggesting a potential underlying factor of general preference for music. This means that people who enjoy any particular music style are more likely to also enjoy any other style. There are also individuals who do not show any preference for music, regardless of the style. In accordance with previous studies, the preferences for instrumental and vocal-instrumental music were also significantly positively correlated in our study ($r = .396$, $p < .001$, $N = 423$). In order to control for the effects of this correlation, we used the preference for instrumental music as a predictor of the preference for vocal-instrumental music, and *vice versa*. We performed two separate forward stepwise regression analyses and determined the best model for prediction of the preference for instrumental and vocal-instrumental music, which are shown in Table 3 and Table 4, respectively.

We explained 33.3% of the instrumental music preferences' variance, with the preference for vocal-instrumental music, cognitive use of music, mother's degree of education, duration of music education and intelligence as significant predictors (see Table 3). The predictive power of intelligence and cognitive use of music after controlling for the other predictors provides further evidence of their importance in prediction of the preference for instrumental music. The predictiveness of the preference for vocal-instrumental music lends additional support to the idea of an existence of a general preference for music.

Mothers' degree of education was a significant predictor, but the same was not true for fathers' degree of education, which is consistent with the results of previous studies that showed mothers' characteristics to be more correlated with children's characteristics than those of fathers (Letina, 2007). There is, however, a significant relationship between both parents' degrees of education and being involved in extracurricular music education ($r_{mother} = 0.133$, $p = .004$, $N = 477$; $r_{father} = 0.121$, $p = .008$, $N = 474$), as well as its duration ($r_{mother} = 0.108$, $p = .019$, $N = 473$; $r_{father} = 0.103$, $p = .025$, $N = 470$). Participants whose parents had a higher degree of education were more likely to have a more structured type of music education, which they also pursued for lon-

Table 3
Forward Stepwise Regression Analysis for the Preference for Instrumental Music (N = 373)

Variable	*B*	*SE*	β	*t*	*p*	R^2
Preference for vocal-instrumental music	.578	.077	.326	7.535	.001	
Cognitive use of music	.340	.051	.290	6.647	.001	
Mother's degree of education	.154	.042	.163	3.646	.001	
Duration of music education	.006	.001	.175	3.947	.001	
Intelligence	.019	.007	.134	2.989	.003	
						$.333^{**}$

** $p < .01$.

Table 4
Forward Stepwise Regression Analysis for the Preference for Vocal-Instrumental Music (N = 373)

Variable	*B*	*SE*	β	*t*	*p*	R^2
Preference for instrumental music	.218	.027	.387	8.138	.001	
Monthly income	−.046	.017	−.130	−2.712	.007	
Gender	.143	.054	.127	2.664	.008	
						.175**

** $p < .01$.

ger periods of time than participants whose parents were less educated. It is possible that more educated parents provide more encouragement for their children to get involved in extracurricular activities, choose programs of higher quality, and persist in them. Prolonged participation in music education is later reflected in children's music preferences.

The type of music education pursued by a student did not significantly contribute to the prediction of a preference for instrumental music, but unsurprisingly, its duration did. We found a very strong Spearman correlation coefficient between the type of music education and its duration ($r = .972$, $p < .001$, $N = 478$), suggesting that participants who take part in more structured music education persist in it longer than those whose music education is less structured. With a longer duration of music education, any differences arising from its type lose in importance when it comes to predicting music preferences. However, as our sample is asymmetrical toward more structured music education (the majority of our participants that have pursued a music education have been music school students), we advise investigation of this matter on a structurally more diverse sample before making definite conclusions.

In the regression analysis of the preferences for vocal-instrumental music, we explained 17.5% of variance, with a preference for instrumental music, monthly income, and gender as predictors with significant individual contributions (see Table 4). Although intelligence was significantly correlated to the preference for vocal-instrumental music, it did not have predictive power in this model. This suggests that other variables are of a relatively higher importance in explaining the preference for vocal-instrumental music. As in the first regression analysis, the significant predictiveness of the other music type provides evidence of the existence of an underlying factor of a preference for music in general.

Contrary to Kanazawa and Perina (2012), who did not find a significant relationship between family income and a preference for either of the two music types, we found income to be a significant predictor of the preference for vocal-instrumental music: participants coming from families with a lower monthly income were more likely to prefer vocal-instrumental music. Interestingly, despite the significant Spearman correlation coefficients between the income and both parents' degrees of education ($r_{mother} = 0.382$, $p < .001$, $N = 461$; $r_{father} = 0.408$, $p < .001$, $N = 458$), participants coming from lower-income families were not less likely to participate in an extracurricular music education ($r = .062$, $p = .185$, $N = 465$). Furthermore, the income difference was not reflected in music education type ($r = .081$, $p = .082$, $N = 465$), nor duration ($r = .064$, $p = .173$, $N = 461$). This suggests that the relationship between income and music preferences could be mediated through variables other than parents' education degrees, for instance, peer relationships, or differences in upbringing. This, however, surpasses the scope of this study.

Another significant predictor of the preference for vocal-instrumental music was gender, and according to our results, women have a higher preference for this type of music. This gender difference could perhaps be a reflection of sexual dimorphism in music evolution, originally proposed by Darwin (1871). Darwin argued that music evolved through sexual selection, as a courtship display for the purpose of increasing reproductive success. According to Miller (2000), courtship evolved into two distinctive displays: language displays targeting receivers' conceptual systems, and music displays aimed at receivers' emotional systems. Because vocal-instrumental music combines language and emotion, it should be the ultimate courtship display. Because of women's higher parental investment (Trivers, 1972), the courtship has been reserved for men, and evolution has favored women who were more selective in their mate choice. Women's higher responsiveness to vocal-instrumental music could mean that they experience it as courtship, but this should be tested in an experimental setting, perhaps similar to that used by Charlton (2014), whose research showed that women's music preferences change during the menstrual cycle. Women showed a higher preference for more complex instrumental music at peak fertility times, but not outside them. Broadening his original research scope to include vocal-instrumental music would allow for a comparison between the relative importance of complexity and music type (instrumental and vocal-instrumental).

Music Preferences and Uses of Music

In order to examine the similarities between the Scale of Music Preferences used in this research and the one used by Rentfrow and Gosling (2003), we performed a factor analysis. We used a method of principal axis, with direct oblimin rotation, and the pattern matrix is shown in Table 5. The factor loadings below .29 were suppressed.

We did not obtain a simple factor structure, as some of the styles loaded onto more than one factor. The equivalents of styles that loaded onto Rentfrow and Gosling's (2003) Reflective and Complex factor were distributed between two factors—reflective and sophisticated. The equivalents of the intense and rebellious factor's music styles loaded on the intense factor. The equivalents of styles from Rentfrow and Gosling's (2003) upbeat and conventional and energetic and rhythmic factors were divided between the popular factor and the conservative factor. Table 6 shows Pearson's correlation coefficients between the five factors and a cognitive use of music.

Confirming our hypothesis, we found the cognitive use of music to be significantly positively correlated to the preferences for music of reflective, intense and sophisticated factors. The correlation between music preferences for the styles of the popular and conservative factors and the cognitive use of music was also significant, but negative. This could mean that participants who prefer this type of music choose to listen to it for different reasons than the appreciation of musicians' talent or technical abilities, which we think should be further investigated. Furthermore, we examined the correlations between preferences for these music styles and general intelligence (see Table 7).

Table 5
Pattern Matrix of the Scale of Music Preferences

Music preferences	Factors				
	Reflective	Popular	Conservative	Intense	Sophisticated
Big band	.910				
Blues	.773				
Jazz	.766				
Ambient/New age/Chill out	.507				
Reggae/Ska/Dub	.427				−.425
Pop		.886			
R'n'B		.847			
Latin		.780			
Folk			.882		
Patriotic			.701		
Commercial			.697		
Turbofolk			.547		
Spiritual/Religious	.334		.364		
Metal				.752	
Punk				.727	
Rock				.683	
Electronic/Dance				.376	
Classical instrumental music	.384				.533
Opera					.490
Rap/Hip hop		.421			−.432

Table 6
Pearson Correlation Coefficients Between the Music Preferences Factors and the Cognitive Use of Music

Factors	r	Cognitive use of music	
		p	N
Reflective	.298	.000	447
Popular	−.267	.000	458
Conservative	−.138	.003	456
Intense	.272	.000	453
Sophisticated	.285	.000	461

Our results show that the music preferred by the participants of higher intelligence is for the most part the same music that is more likely to be preferred by those individuals who reported using music cognitively. Significant positive correlations between general intelligence and preferences for music of reflective, intense and sophisticated factors are in accordance with results obtained by Rentfrow and Gosling (2003). However, the significant positive correlation we found between popular music and general intelligence is contradictory to the negative correlation between intelligence and a preference for the music of Upbeat and Conventional factors discovered by Rentfrow and Gosling. However, this did not come as a surprise, as we had already confirmed a positive relationship between intelligence and a preference for vocal-instrumental music—to which all of the popular music styles belong to—as well as a positive relationship between the preferences for instrumental and vocal-instrumental music.

Blumler and Katz (1974) argued that people choose to use the media they believe will satisfy their psychological or social needs. People with higher intelligence tend to look for cognitive stimulation. With regard to music, such individuals could satisfy their psychological needs by listening to complex musical pieces that incite them to analyze the chords, rhythm and melody, or appreciate the virtuosity of musicians' performance. The enjoyment of this kind of music requires concentration and cognitive effort, and the individuals who look for a different kind of stimulation (e.g., emotional) would not be attracted to music styles such as classical instrumental music, big band or opera. The cognitive use of music was a significant predictor for the preference for instrumental music, but not for the vocal-instrumental music.

According to Kanazawa's hypothesis, complexity of music should not play a role in the relationship between intelligence and music preferences. This was confirmed by results of previous research (Kanazawa & Perina, 2012). The authors explained that a preference for a simple type of instrumental music should be positively correlated with higher intelligence, whereas such a relationship should not be found between intelligence and a preference for complex vocal-instrumental music. Results of comparative research showed that a number of species prefer more complex vocalizations to those of less complexity (Ryan & Keddy-Hector, 1992), which can be used as an argument for the preference for complex music being evolutionarily familiar. These findings might indicate a possible supremacy of novelty over complexity, which could be the reason why complexity plays no role in the relationship between intelligence and music preferences. Since intelligence is not expected to be a predictor of a preference for vocal-instrumental music, the complexity or simplicity of such music should not influence people's preference for it, regardless of their intelligence.

Conclusion

In this study, we provide new information on the relationship between intelligence and music preferences from the perspective of evolutionary psychology. Our findings regarding the role of intelligence in prediction of the preference for instrumental music confirm those of Kanazawa and Perina (2012). Our use of a differ-

Table 7
Pearson Correlation Coefficients Between Music Factors and General Intelligence, Expressed as Scores on the Non-Verbal Intelligence Test

Factors	r	General intelligence	
		p	N
Reflective	.220	.000	443
Popular	.105	.025	452
Conservative	−.262	.000	452
Intense	.261	.000	448
Sophisticated	.255	.000	455

ent set of predictors, as well as a nonverbal measure of general intelligence further corroborates the hypothesis. The additional significant relationship we unexpectedly revealed is the one between intelligence and the preference for vocal-instrumental music. However, as it is of a significantly lower value, it in fact adds support to the Savanna-IQ interaction hypothesis (Kanazawa & Hellberg, 2010). Furthermore, we found another significant predictor of the preference for instrumental (but not vocal-instrumental) music in the cognitive use of music—a variable previously recognized as an important one that should be included in this type of research (Chamorro-Premuzic & Furnham, 2007; Kanazawa & Perina, 2012). We also confirmed significant positive correlations between the cognitive use of music and the preference for music of reflective, complex and intense music styles, as well as the significant positive correlation between preferences for these music genres and intelligence. Our findings enable better comprehension of the experience of music, which carries implications that extend to cognitive psychology and psychology of music.

Despite its large size and a high diversity on a number of variables, our sample was homogeneous in respect to participants' age and level of education. Because music preferences change with age (Butkovic et al., 2011), the range of our conclusions is limited. We therefore recommend that future studies have a wider research scope and include participants of varying age and education levels. We are of the opinion that this will enable for more general conclusions about the complex relationship between music preferences and intelligence. A longitudinal study would be an even more sophisticated approach, as it would enable a detailed investigation of the effects of the developmental changes, not only on music preferences, but also on their relationships with numerous social and personal variables. Important new knowledge could also be gained from a cross-cultural study, in which many social variables (such as differences in societal pressures, peer relationships, educational systems or culturally specific ways of experiencing music or music-related behaviors) could be examined and controlled for.

References

Blumler, J. G., & Katz, E. (1974). *The uses of mass communication*. Newbury Park, CA: Sage.

Brown, S. (2000). The "musilanguage" model of music evolution. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 271–300). Cambridge, MA: MIT Press.

Butkovic, A., Vukasovic, T., & Bratko, D. (Eds.). (2011). *Ličnost i glazbene preferencije: XX. Ljetna psihologijska škola* [Personality and music preferences: XX. Summer Psychology School]. Zagreb, Croatia: FF press.

Chamorro-Premuzic, T., & Furnham, A. (2007). Personality and music: Can traits explain how people use music in everyday life? *British Journal of Psychology, 98,* 175–185. http://dx.doi.org/10.1348/000712606X111177

Charlton, B. D. (2014). Menstrual cycle phase alters women's sexual preferences for composers of more complex music. *Proceedings of the Royal Society, 281,* 20140403. http://dx.doi.org/10.1098/rspb.2014.0403

Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London, England: John Murray.

Fitch, W. T. (2006). The biology and evolution of music: A comparative perspective. *Cognition, 100,* 173–215. http://dx.doi.org/10.1016/j.cognition.2005.11.009

Flanagan, D. P., Ortiz, S. O., & Alfonso, V. C. (2013). *Essentials of cross-battery assessment* (Vol. 84). Hoboken, NJ: Wiley.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York, NY: Basic Books.

Hargreaves, D. J., Miell, D., & Macdonald, R. A. R. (2002). What are musical identities and why are they important? In D. J. Hargreaves, D. Miell, & R. A. R. Macdonald (Eds.), *Musical identities* (pp. 1–20). New York, NY: Oxford University Press.

Kanazawa, S. (2004). General intelligence as a domain-specific adaptation. *Psychological Review, 111,* 512–523. http://dx.doi.org/10.1037/0033-295X.111.2.512

Kanazawa, S. (2006a). IQ and the wealth of states. *Intelligence, 34,* 593–600. http://dx.doi.org/10.1016/j.intell.2006.04.003

Kanazawa, S. (2006b). Why the less intelligent may enjoy television more than the more intelligent. *Journal of Cultural and Evolutionary Psychology, 4,* 27–36. http://dx.doi.org/10.1556/JCEP.4.2006.1.2

Kanazawa, S. (2008). IQ and the health of states. *Biodemography and Social Biology, 54,* 200–213. http://dx.doi.org/10.1080/19485565.2008.9989142

Kanazawa, S. (2010a). Evolutionary psychology and intelligence research. *American Psychologist, 65,* 279–289. http://dx.doi.org/10.1037/a0019378

Kanazawa, S. (2010b). Why liberals and atheists are more intelligent. *Social Psychology Quarterly, 73,* 33–57. http://dx.doi.org/10.1177/0190272510361602

Kanazawa, S. (2012). Intelligence and homosexuality. *Journal of Biosocial Science, 44,* 595–623. http://dx.doi.org/10.1017/S0021932011000769

Kanazawa, S. (2014). Intelligence and childlessness. *Social Science Research, 48,* 157–170. http://dx.doi.org/10.1016/j.ssresearch.2014.06.003

Kanazawa, S., & Hellberg, J. E. (2010). Intelligence and substance use. *Review of General Psychology, 14,* 382–396. http://dx.doi.org/10.1037/a0021526

Kanazawa, S., & Perina, K. (2009). Why night owls are more intelligent. *Personality and Individual Differences, 47,* 685–690. http://dx.doi.org/10.1016/j.paid.2009.05.021

Kanazawa, S., & Perina, K. (2012). Why more intelligent individuals like classical music. *Journal of Behavioral Decision Making, 25,* 264–275. http://dx.doi.org/10.1002/bdm.730

Kaufman, A. S. (2009). *IQ Testing 101*. New York, NY: Springer Publishing.

Letina, S. (2007). *Family study of emotional intelligence* (Unpublished doctoral dissertation). Zagreb, Croatia: Faculty of Humanities and Social Sciences, University of Zagreb.

Ljubotina, D. (2017). *Prirucnik za Neverbalni test nizova*. [Manual for the Nonverbal Sequence Test]. Zagreb, Croatia: FF Press. Manuscript in preparation.

McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence, 37,* 1–10. http://dx.doi.org/10.1016/j.intell.2008.08.004

Miller, G. F. (2000). Evolution of human music through sexual selection. In N. L. Wallin, B. Merker, & S. Brown (Eds.), *The origins of music* (pp. 329–360). Cambridge, MA: MIT Press.

Raven, J., Raven, J. C., & Court, J. H. (2003). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 1: General overview*. San Antonio, TX: Harcourt Assessment.

Rentfrow, P. J., & Gosling, S. D. (2003). The do re mi's of everyday life: The structure and personality correlates of music preferences. *Journal of Personality and Social Psychology, 84,* 1236–1256. http://dx.doi.org/10.1037/0022-3514.84.6.1236

Ryan, M. J., & Keddy-Hector, A. (1992). Directional patterns of female mate choice and the role of sensory biases. *American Naturalist, 139,* S4–S35. http://dx.doi.org/10.1086/285303

Sacks, O. (2008). *Musicophilia*. London, England: Picador.

Schellenberg, E. G. (2004). Music lessons enhance IQ. *Psychological Science, 15,* 511–514. http://dx.doi.org/10.1111/j.0956-7976.2004.00711.x

SPSS Inc. (2008). *SPSS statistics for Windows (Version 17.0)*. Chicago, IL: SPSS.

Trivers, R. (1972). *Parental investment and sexual selection*. Cambridge, MA: Biological Laboratories, Harvard University.

Vuoskoski, J. K., Thompson, W. F., McIlwain, D., & Eerola, T. (2012). Who enjoys listening to sad music and why? *Music Perception, 29,* 311–317. http://dx.doi.org/10.1525/mp.2012.29.3.311

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