Journal of Behavioral Decision Making, *J. Behav. Dec. Making* **25**: 264–275 (2012)
DOI: 10.1002/bdm.730

Why More Intelligent Individuals Like Classical Music

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ABSTRACT

The origin of values and preferences is an unresolved theoretical problem in social and behavioral sciences. The Savanna-IQ Interaction Hypothesis, derived from the Savanna Principle and a theory of the evolution of general intelligence, suggests that more intelligent individuals are more likely to acquire and espouse evolutionarily novel values and preferences than less intelligent individuals but that general intelligence has no effect on the acquisition and espousal of evolutionarily familiar values and preferences. Recent work on the evolution of music suggests that music in its evolutionary origin was always vocal and that purely instrumental music is evolutionarily novel. The Savanna-IQ Interaction Hypothesis would then imply that more intelligent individuals are more likely to prefer purely instrumental music than less intelligent individuals, but general intelligence has no effect on the preference for vocal music. The analyses of American (General Social Surveys) and British (British Cohort Study) data are consistent with this hypothesis. Additional analyses suggest that the effect of intelligence on musical preference is not a function of the cognitive complexity of music. Copyright © 2011 John Wiley & Sons, Ltd.

KEY WORDS origin of values and preferences; evolutionary psychology; the Savanna Principle; the Savanna-IQ Interaction Hypothesis; evolutionary origin of music

Where do individuals' values and preferences come from? Why do people like or want what they do? The origin of individual values and preferences is one of the remaining theoretical puzzles in social and behavioral sciences (Kanazawa, 2001). In particular, values and preferences occupy a central role in the process of decision making (Ariely & Loewenstein, 2006; Hechter, Ranger-Moore, Jasso, & Horne, 1999; Yates & Tschirhart, 2006).

Recent theoretical developments in evolutionary psychology may suggest one possible explanation (Kanazawa, 2010b). On the one hand, evolutionary psychology (Crawford, 1993; Symons, 1990; Tooby & Cosmides, 1990) posits that the human brain, just like any other organ of any other species, is designed for and adapted to the conditions of the ancestral environment (roughly the African savanna during the Pleistocene Epoch), not necessarily to those of the current environment. It may therefore have difficulty comprehending and dealing with entities and situations that did not exist in the ancestral environment (Kanazawa, 2002, 2004a).

On the other hand, an evolutionary psychological theory of the evolution of general intelligence proposes that general intelligence may have evolved as a domain-specific adaptation to solve evolutionarily novel problems, for which there are no predesigned psychological adaptations (Kanazawa, 2004b, 2008). Such evolutionarily novel, nonrecurrent adaptive problems may have included, for example, how to escape a forest fire caused by lightning striking a tree, how to find new sources of food in a severe drought that has never been encountered before, and how to cross a rapid river in the midst of a flash flood. What characterizes the domain of evolutionarily novel problems is their logical solvability; all evolutionarily novel problems have logical solutions (Kanazawa, 2010b, pp. 282–283).

The logical conjunction of these two theories, *the Savanna-IQ Interaction Hypothesis* (Kanazawa, 2010a), implies that the human brain's difficulty with evolutionarily novel stimuli may interact with general intelligence, such that more intelligent individuals have less difficulty with such stimuli than less intelligent individuals. In contrast, general intelligence may not affect individuals' ability to comprehend and deal with evolutionarily familiar entities and situations.

Evolutionarily novel entities that more intelligent individuals are better able to comprehend and deal with may include ideas and lifestyles, which form the basis of their values and preferences; it would be difficult for individuals to prefer or value something that they cannot truly comprehend. Comprehension does not equal preference. Although not everyone who comprehends certain entities would thereby acquire preferences for them, we assume some would, whereas few (if any) who do not comprehend them would acquire preferences for them.

Hence, applied to the domain of preferences and values, the Hypothesis suggests that more intelligent individuals are more likely to acquire and espouse evolutionarily novel preferences and values that did not exist in the ancestral environment than less intelligent individuals, but general intelligence has no effect on the acquisition and espousal of evolutionarily familiar preferences and values that existed in the ancestral environment (Kanazawa, 2010a).

There has been emerging evidence for the Hypothesis as an explanation for individual preferences and values. First, more intelligent children are more likely to grow up to espouse left-wing liberalism (Deary, Batty, & Gale, 2008; Kanazawa, 2010a), possibly because genuine concerns with genetically unrelated others and willingness to contribute

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private resources for the welfare of such others—liberalism—may be evolutionarily novel. Even though past studies show that women are more liberal than men (Lake & Breglio, 1992; Shapiro & Mahajan, 1986; Wirls, 1986) and blacks are more liberal than whites (Kluegel & Smith, 1986; Sundquist, 1983), the effect of childhood intelligence on adult liberalism is twice as large as the effect of sex or race (Kanazawa, 2010a).

Second, more intelligent children are more likely to grow up to be atheists (Kanazawa, 2010a), possibly because belief in higher powers, as a consequence of over-inference of agency behind otherwise natural phenomena, may be part of evolved human nature (Atran, 2002; Boyer, 2001; Guthrie, 1993; Haselton & Nettle, 2006; Kirkpatrick, 2005), and atheism may therefore be evolutionarily novel. Even though past studies show that women are much more religious than men (Miller & Hoffmann, 1995; Miller & Stark, 2002), the effect of childhood intelligence on adult religiosity is twice as large as that of sex (Kanazawa, 2010a).

Third, more intelligent boys (but not more intelligent girls) are more likely to grow up to value sexual exclusivity (Kanazawa, 2010a), possibly because humans were naturally polygynous throughout evolutionary history (Alexander, Hoogland, Howard, Noonan, & Sherman, 1979; Harvey & Bennett, 1985; Kanazawa & Novak, 2005; Leutenegger & Kelly, 1977; Pickford, 1986). Either under monogamy or polygyny, women are expected to be sexually exclusive to one mate; in sharp contrast, men in polygynous marriage are not expected to be sexually exclusive to one mate, whereas men in monogamous marriage are. So, sexual exclusivity may be evolutionarily novel for men but not for women.

Fourth, more intelligent children are more likely to grow up to be nocturnal, going to bed and waking up later (Kanazawa & Perina, 2009), possibly because nocturnal life was rare in the ancestral environment where our ancestors did not have artificial sources of illumination until the domestication of fire. Ethnographies of contemporary hunter-gatherers suggest that our ancestors may have woken up shortly before dawn and gone to sleep shortly after dusk. Night life may therefore be evolutionarily novel.

Fifth, the human consumption of psychoactive substances, such as alcohol, tobacco, and drugs, is evolutionarily novel, all originating less than 10 000 years ago. Thus, the Hypothesis would predict that more intelligent individuals are more likely to consume alcohol, tobacco, and drugs. The analyses of two prospectively longitudinal data sets with nationally representative samples in the UK and the USA support the prediction. More intelligent individuals consume more alcohol more frequently, smoke more tobacco (but only in the USA), and use more illegal drugs (Kanazawa & Hellberg, 2010).

Finally, criminals on average have lower intelligence than the general population (Wilson & Herrnstein, 1985; Herrnstein & Murray, 1994). This is consistent with the Hypothesis because, although much of what we call interpersonal crime today is evolutionarily familiar, the institutions that control, detect, and punish such behavior are evolutionarily novel (Kanazawa, 2009). Murder, assault, robbery, and theft were probably routine means of intrasexual male competition for resources and mates in the ancestral environment. We may infer this from the fact that behavior that would be classified as criminal if engaged in by humans are quite common among other species (Ellis, 1998), including other primates (de Waal, 1989, 1992; de Waal, Luttrell, & Canfield, 1993). It also explains the “exception that proves the rule,” why more intelligent individuals are more likely to consume illegal drugs (Kanazawa & Hellberg, 2010). Unlike most interpersonal and property crimes, the consumption of such substances is evolutionarily novel. It is not legality per se that matters but evolutionary novelty of the behavior.

However, there was very little formal third-party enforcement of norms in the ancestral environment, only second-party enforcement (victims and their kin and allies) or informal third-party enforcement (ostracism). It therefore makes sense from the perspective of the Hypothesis that men with low intelligence may be more likely to resort to evolutionarily familiar means of competition for resources (theft rather than full-time employment) and mating opportunities (rape rather than computer dating) and not to comprehend fully the consequences of criminal behavior imposed by evolutionarily novel entities of law enforcement.

EVOLUTIONARY ORIGINS OF MUSIC

What is the evolutionary origin of music? Why are humans musical?

In comparison to evolutionary origins and functions of language and art, anthropologists and archeologist have paid scant attention to the origin of music. In his book *The Singing Neanderthals: The Origins of Music, Language, Mind and Body* (2005), the cognitive archeologist Steven Mithen offers a novel theory of the evolution of music. Mithen argues that language and music had a common precursor, in what Brown (2000) calls “musilanguage,” which later developed into two separate systems of music and language.

There are two distinct approaches to the evolution of language. The *compositional* approach (Bickerton, 1990; Jackendoff, 2000) avers that words came before sentences. A lexicon of words that referred to specific entities, such as “meat,” “fire,” and “hunt,” emerged first and were later combined into phrases and then sentences. Grammar emerged at the end to dictate how words could be combined into sentences.

In contrast, the *holistic* approach (Wray, 1998) proposes that sentences came before words. It suggests that the precursor to human language was a communication system composed of messages in the form of arbitrary strings of sounds rather than words. Each indivisible utterance or sequence of sounds was associated with a specific meaning. These utterances were later segmented into words, which could then be recombined to create further utterances.

Mithen favors the latter view. As evidence, he points to the fact that all nonhuman primate utterances, such as vervet monkey’s alarm calls, rhythmic chatters of geladas, duets of pair-bonded gibbons, and pant-hoots of chimpanzees, are

DOI: 10.1002/bdm

holistic and indivisible (Mithen, 2005, pp. 105–121). In other words, nonhuman primates do not have words, even though their utterances as a whole convey specific meanings and emotions. Some primatologists disagree, however. Zuberbühler (2002, 2003), for example, argues, in support of the compositional approach, that Diana and Campbell's monkey calls have both syntactic and semantic rules, which can be used to combine elements ("words") to produce further utterances. The debate on the origin of human language between the compositional and holistic approaches is far from closed.

Studies demonstrate that the meanings and the emotions of primate utterances may be shared by different primate species. When macaque vocalizations made in specific social contexts as expressions of contentment, pleading, dominance, anger, and fear are recorded and then played back, Finnish children and adults are able to interpret accurately what the expressed emotions are (Leinonen, Linnankoski, Laakso, & Aulanko, 1991; Linnankoski, Laakso, Aulanko, & Leinonen, 1994). Another study shows that words spoken by Finnish and English speakers in the social context of contentment, pleading, dominance, anger, and fear have the same acoustic waveforms as the macaque vocalizations made in the corresponding contexts (Leinonen, Laakso, Carlson, & Linnankoski, 2003). It is as though humans and macaques may be able to communicate with each other through the use of *holistic utterances and messages*.

Mithen contends that human proto-language was *holistic*, *manipulative* (it was designed to induce desired emotions and behavior in other individuals), *multimodal* (it involved not only vocal utterances but also gesture and dance), *musical* (the utterances had distinct pitches, rhythms, and melodies), and *mimetic*. This proto-language eventually evolved into two systems of communication: music to express emotions and language to transmit information. To demonstrate the common evolutionary origin of music and language, Mithen (2005, pp. 28–68) surveys a large number of clinical cases of individuals with amusia (absence of musical abilities while retaining some linguistic abilities) and aphasia (absence of linguistic abilities while retaining some musical abilities). These case studies largely show that music and language are based on discrete modules in the brain; some of these are separate and dedicated to one or the other, whereas others are *shared*.

If Mithen is right, if music and language share a common evolutionary origin in holistic, musical utterances designed to convey messages, one possible implication is that music, in its evolutionary origin, was necessarily and invariably *vocal*. If Mithen is right, then all music in its evolutionary origin were *songs* that individuals sang to express their desires and emotions, in an attempt to induce desired emotions and behavior in others. In other words, *music in its evolutionary origin was never purely instrumental*.

It may be instructive to note in this context that Blackfoot Indians have a word for "song" but not for "instrumental music" (Nettl, 1983). The language of the Pirahã in the Amazon forest in Brazil (Everett, 2005) may be an extant example of a musilanguage, which Mithen envisions as the precursor to the modern language and music. Although the Pirahã language does have words, it has the fewest number of vowels (three) and consonants (seven for women, eight for men) of all known human languages. "The Pirahã people communicate almost as much by singing, whistling, and humming as they do using consonants and vowels. Pirahã prosody is very rich, with a well-documented five-way weight distinction between syllable types" (Everett, 2005, p. 622).

The former professional musician and current academic linguist (as well as the originator of the holistic approach to the evolutionary origin of language) Alison Wray (2006) notes that, "To my taste, western classical music (as indeed most other musical traditions worldwide) is different in kind [from musical expressions in evolutionary history]. Its production is, for a start, subject to a heavy burden of learning that few master. There is no naturally facilitated access to the comprehension (let alone creation) of the kinds of melodies, harmonies and rhythms found in the works of Bach or Schoenberg: no equivalent—for music of this kind—of first language acquisition." In other words, classical music of Bach, Schoenberg, and others is *evolutionarily novel*, partly, we contend, because it is largely or entirely instrumental.

Consistent with Wray's assertion, we observe that a far greater proportion of the general population can (and spontaneously do) sing songs than play musical instruments. For example, the incidence of tone deafness in the UK is estimated to be about 4–5% (Kalmus & Fry, 1980). In other words, 95% of people can sing adequately (and some of the tone-deaf people nonetheless often do sing). The proportion of the general population who play musical instruments adequately is nowhere near as high. Further, in many cases of playing musical instruments (such as the guitar and the piano), it is often accompanied by singing.

In the context of the Savanna-IQ Interaction Hypothesis, then, the theory by Mithen suggests that *more intelligent individuals today are more likely to appreciate purely instrumental music than less intelligent individuals because such music is evolutionarily novel, while general intelligence has no effect on the appreciation of vocal music*.

The study by Rentfrow and Gosling (2003) shows that more intelligent individuals prefer "reflective and complex" genre of music (which includes classical, jazz, blues, and folk), but they also prefer "intensive and rebellious" music (alternative, rock, and heavy metal). Less intelligent individuals in their study prefer "upbeat and conventional" music (country, pop, religious, and sound tracks). In a recent study, Chamorro-Premuzic and Furnham (2007, p. 177) identify three distinct "uses" of music: "namely emotional (i.e. music for emotional regulation such as mood manipulation), cognitive (i.e. rational musical appreciation or intellectual processing of music), and background (i.e. music as background for social events, work or interpersonal interaction)." Their data show that more intelligent individuals are more likely to use music for "cognitive" purposes, but intelligence is not correlated with the "emotional" use of music. If Mithen's view of the evolution of music is correct, then the original function of music was to induce certain

DOI: 10.1002/bdm

emotions in self and others, and its "cognitive" use would be evolutionarily novel. It is therefore possible to interpret the findings by Chamorro-Premuzic and Furnham (2007) as being consistent with the prediction of the Savanna-IQ Interaction Hypothesis.

In the following section, we will provide an empirical test of our hypothesis that more intelligent individuals are more likely to prefer purely instrumental music than less intelligent individuals, but general intelligence has no effect on individuals' preference for vocal music. We will test the hypothesis with both American and British data with large, representative samples.

EMPIRICAL ANALYSES

American sample

Data

The National Opinion Research Center at the University of Chicago has administered the General Social Surveys (GSS) either annually or biennially since 1972. Personal interviews are conducted with a nationally representative sample of non-institutionalized adults in the USA. The sample size is about 1500 for each annual survey and about 3000 for each biennial one. The exact questions asked in the survey vary by the year. In our analysis, we use the 1993 GSS, which includes specific questions about the respondents' taste in music.

Dependent variable: music preference

In 1993 only, the GSS asks its respondents about their preference for 18 different types of music. The question is "I'm going to read you a list of some types of music. Can you tell me which of the statements on this card comes closest to your feeling about each type of music?" The respondent can answer on a five-point scale (reverse coded): 1 = dislike it very much; 2 = dislike it; 3 = have mixed feelings; 4 = like it; and 5 = like it very much. The 18 genres of music asked are "big band," "bluegrass," "country western," "blues or R&B," "Broadway musicals," "classical," "folk," "gospel," "jazz," "Latin," "easy listening," "new age," "opera," "rap," "reggae," "contemporary rock," "oldie," and "heavy metal."

Of the 18 types of music, we classify big band, classical, and easy listening as entirely or largely "instrumental" and the rest as entirely or largely "vocal." We admit that the dichotomization is necessarily approximate at best; for example, some of both classical and big band music is vocal. However, we classify the genres according to whether *the majority* of the genre is largely instrumental or vocal.

It is debatable whether or not jazz is largely instrumental or largely vocal. However, all our substantive conclusions below remain exactly the same if we classify it as instrumental. Because Rentfrow and Gosling (2003) show that more intelligent individuals prefer to listen to jazz, our classification of jazz as largely vocal provides a statistically conservative test of our prediction derived from the Savanna-IQ Interaction Hypothesis. The fact that there are so many more vocal musical genres than instrumental ones in itself suggests the vocal origin of music.

For a measure of preference for instrumental music, we compute the mean score for the three instrumental genres; for a measure of preference for vocal music, we compute the mean score for the 15 vocal genres. In constructing these indices and using them as dependent variables in ordinary least squares (OLS) regression models, we in effect treat the original five-point ordinal scale as interval. However, treating the dependent variables as ordinal and using the ordinal regression models (McCullagh, 1980) produce identical substantive conclusions.

Independent variable: intelligence

The GSS measures the verbal intelligence of its respondents by asking them to select a synonym for a word out of five candidates. Half the respondents in each GSS sample (including the 1993 sample that we use) answer 10 of these questions, and their total score (the number of correct responses) varies from 0 to 10. The raw score is then normalized into a standard IQ metric, with a mean of 100 and a standard deviation of 15.

This is strictly a measure of verbal intelligence, not of general intelligence. However, verbal intelligence is known to be highly correlated with (and thus heavily loads on) general intelligence. The extensive review of 36 studies by Miner (1957) showed that the median correlation between vocabulary and general intelligence is 0.83. Wolfle (1980) reported that the correlation between a full-scale IQ test (Army General Classification Test) and the GSS synonyms measure that we use here is 0.71. As a result, the GSS synonyms measure has been used widely by intelligence researchers to assess trends in general intelligence (Huang & Hauser, 1998).

Control variables

In addition to intelligence, we control for the following variables in the OLS regression models: age (in years); race (1 if black); sex (1 if male); education (in years of formal schooling); annual family income (in 21 equidistant ordinal categories, from 1 = less than \$1000 to 21 = more than \$75 000, treated here as interval); religion (in four dummies for Catholic, Jewish, Protestant, and other, with none as the reference category); whether the respondent is currently married (1 if yes); whether the respondent has ever been married (1 if yes); and the total number of children.

Results

The inspection of the variance inflation factors for all independent variables suggests that multicollinearity is not a problem at all in our regression analysis (O'Brien, 2007). Table 1 presents the analysis of the 1993 GSS data. Column (1) shows the result of the OLS multiple regression analysis where the GSS respondents' mean preference for instrumental music is regressed on their verbal intelligence and a set of

Table 1. Effect of intelligence on preference for instrumental versus vocal music, American sample (U.S. General Social Survey, 1993)

	(1)	(2)
	Instrumental	Vocal
Verbal intelligence	0.0069**	0.0034
	(0.0022)	(0.0018)
	0.1245	*0.0954*
Age	0.0139****	−0.0048**
	(0.0019)	(0.0016)
	0.2880	*−0.1462*
Race (1 = black)	−0.1053	0.0908
	(0.1002)	(0.0782)
	−0.0369	*0.0518*
Sex (1 = male)	−0.0606	−0.0789
	(0.0548)	(0.0438)
	−0.0375	*−0.0769*
Education	0.0549****	0.0199*
	(0.0111)	(0.0092)
	0.2075	*0.1152*
Family income	0.0065	0.0041
	(0.0066)	(0.0053)
	0.0407	*0.0411*
Religion		
Catholic	0.1411	−0.0364
	(0.1055)	(0.0801)
	0.0731	*−0.0293*
Protestant	0.0031	0.0057
	(0.0963)	(0.0709)
	0.0019	*0.0054*
Jewish	−0.2856	0.0724
	(0.2251)	(0.1628)
	−0.0452	*0.0199*
Other	0.1656	0.0234
	(0.2034)	(0.1642)
	0.0299	*0.0064*
Currently married (1 = yes)	−0.0603	−0.1079
	(0.0721)	(0.0588)
	−0.0371	*−0.1049*
Ever married (1 = yes)	0.1344	0.0149
	(0.0961)	(0.0756)
	0.0634	*0.0121*
Number of children	−0.0362	−0.0140
	(0.0188)	(0.0163)
	−0.0769	*−0.0450*
Constant	1.2875	2.7123
	(0.2413)	(0.1868)
R^2	0.1659	0.0925
n	786	543

Note: "Instrumental" music includes "big band," "classic," and "easy listening."
"Vocal" music includes "blues," "bluegrass," "contemporary rock," "country," "folk," "gospel," "heavy metal," "jazz," "Latin," "musicals," "new age," "oldies," "opera," "rap," and "reggae."
Main entries are unstandardized regression coefficients.
Numbers in parentheses are standard errors.
Numbers in italics are standardized coefficients (betas).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, and **** $p < 0.0001$.

control variables. It shows that, net of age, race, sex, education, family income, religion, current and past marital status, and the number of children, more intelligent Americans are more likely to prefer instrumental music (such as big band, classical, and easy listening) than less intelligent Americans. Consistent with the prediction derived from the Savanna-IQ Interaction Hypothesis, verbal intelligence significantly increases the preference for instrumental music among the GSS respondents ($b = 0.0069$, $p < 0.01$, beta = 0.1245). The effect size for intelligence, using the standardized regression coefficient as a proxy, is 0.1245, which is moderate for survey data. The only other significant predictors of preference for instrumental music are age ($b = 0.0139$, $p < 0.0001$, beta = 0.2880) and education ($b = 0.0549$, $p < 0.0001$, beta = 0.2075). Both age and education significantly increase the respondent's preference for instrumental music, and their effects are stronger than that of intelligence. None of the other sociodemographic characteristics of the respondent significantly predict preference for instrumental music.

Table 1, Column (2), shows the result of the OLS multiple regression analysis where the GSS respondents' mean preference for vocal music is regressed on their verbal intelligence and a set of control variables. It shows that, net of the same control variables, more intelligent Americans are *not* more likely to prefer vocal music. Once again, consistent with the prediction derived from the Savanna-IQ Interaction Hypothesis, intelligence does not significantly affect the preference for vocal music among the GSS respondents ($b = 0.0034$, not significant, beta = 0.0954). As before, age and education significantly predict preference for vocal music, although, unlike with instrumental music, they have opposite effects. Age significantly decreases preference for vocal music ($b = –0.0048$, $p < 0.01$, beta = –0.1462), whereas education significantly increases it ($b = 0.0199$, $p < 0.05$, beta = 0.1152). No other sociodemographic characteristics of the respondent significantly predicts preference for vocal music. The analysis of the GSS data presented in Table 1 supports the prediction of the Savanna-IQ Interaction Hypothesis that more intelligent individuals are more likely to prefer (evolutionarily novel) instrumental music, whereas intelligence has no effect on preference for (evolutionarily familiar) vocal music.

British sample

Data

The British Cohort Study (BCS), originally developed as the British Birth Survey and a sequel to the 1958 National Child Development Study, includes *all* babies born in Great Britain (England, Wales, and Scotland) during the week of 05–11 April 1970. The initial sample contains over 17 000 babies. All surviving members of the cohort, who still reside in the UK (Great Britain plus Northern Ireland), have since been observed in 1975 (at age 5), 1980 (age 10), 1986 (age 16), 1996 (age 26), and 2000 (age 30). We use the 1986 follow-up data because they contain extensive information on the respondents' leisure activity, including musical preferences, as well as a measure of their intelligence.

Dependent variable: music preference

The 1986 follow-up of the BCS asks the respondent's musical preference for 12 different types of music. The question is "What sort of music do you listen to usually?" The respondent can answer a yes or a no to each of the 12 genres. We categorize "classical" and "light music" (easy listening or "elevator music") as entirely or largely "instrumental" music, and "folk music," "disco," "reggae," "soul," "heavy rock," "funk," "electronic,"[1] "punk," "other pop music," and "other" as entirely or largely "vocal" music. For a measure of preference for instrumental music, we compute the mean score across the two instrumental genres; for a measure of preference for vocal music, we compute the mean score for the 10 vocal genres. In constructing these indices and in using them as dependent variables in OLS regression models, we treat the original binary response as interval. However, treating the dependent variables as ordinal and using the ordinal regression models (McCullagh, 1980) produce identical substantive conclusions.

In addition to music preference, BCS86 measures the respondent's TV-viewing habits, by asking about 22 different types of TV programs. The respondent can answer on a three-point scale: 1 = view it as little as I can; 2 = view it some of the time; and 3 = view it as much as I can. Two of the 22 types of TV programs refer to music: pop/rock music and classical music. We use the respondent's preference for viewing music programs on TV as a secondary measure of music preference. Because the dependent variables are on three-point ordinal scale, we use the ordinal regression (McCullagh, 1980) to analyze them.

Independent variable: intelligence

The BCS86 measures the verbal intelligence of its respondents by asking them to select a synonym for a word out of five candidates. These are essentially the same type of questions as the GSS vocabulary test, which is known to correlate very highly with general intelligence (Huang & Hauser, 1998; Miner, 1957; Wolfle, 1980). Each BCS86 respondent answers 75 of these questions. Their raw score (0–75) is normalized into a standard IQ metric, with a mean of 100 and a standard deviation of 15.

Control variables

Because all BCS86 respondents are 16 years old and still in school, we cannot control for their educational achievement; all respondents have had the identical number of years of formal schooling. In order to separate the effect of intelligence from education, we control for the respondent's academic performance. The teacher of each BCS86 respondent rates the student's academic performance on seven-point scales (reverse coded): 1 = "bottom" (bottom 5%); 2 = "well below average" (the next 10%); 3 = "below average" (the next 20%); 4 = "average" (the middle 30%); 5 = "above average" (the next 10%); 6 = "well above average" (the next 10%); and 7 = "top" (the top 5%). We enter this measure of academic performance in our regression models in lieu of educational achievement.

In addition, we control for the following variables: sex (1 = male); race (with five dummies for West Indian, Asian,[2] Chinese, Mixed, and Other, with European as the reference category); religion (with nine dummies for Roman Catholic, the Church of England, Other Christian, Buddhist, Hindu, Islam, Jewish, Sikh, and Other, with None/Atheist as the reference category; however, there are no Buddhist respondents in our sample); family income (on an 11-point equidistant ordinal categories, from 1 = less than £50/week or £2600/year, to 11 = more than £500/week or £26 000/year, treated here as continuous); and mother's and father's education (both measured as the age at which the parent left formal education).

Results

The inspection of the variance inflation factors for all independent variables once again suggests that multicollinearity is not a problem at all in our regression analysis (O'Brien, 2007). Table 2 presents the analysis of the BCS86 respondents' preference for music. Column (1) shows the result of the OLS regression analysis where BCS86 respondents' mean preference for instrumental music is regressed on their verbal intelligence and a set of control variables. It shows that, net of teacher-rated academic performance, sex, race, religion, family income, and mother's and father's education, more intelligent British 16-year-olds are more likely to prefer instrumental music (such as classical and light music) than their less intelligent schoolmates. Consistent with the prediction derived from the Savanna-IQ Interaction Hypothesis, verbal intelligence significantly increases preference for instrumental music among the BCS86 respondents ($b = 0.0023$, $p < 0.01$, beta = 0.0990). The effect size for intelligence, once again using the standardized regression coefficient as a proxy, is small (0.0990). Academic performance also has a significantly positive effect on preference for instrumental music ($b = 0.0301$, $p < 0.001$, beta = 0.1303). Races do not differ in their preference for instrumental music, but Hindu and Sikh religions both have significant positive effects in this model (Hindu: $b = 0.2435$, $p < 0.05$, beta = 0.0767; Sikh: $b = 0.3438$, $p < 0.01$, beta = 0.0857). No other sociodemographic variables included in this model significantly affect preference for instrumental music.

Table 2, Column (2), presents the result of the OLS regression analysis where BCS86 respondents' mean preference for vocal music is regressed on their verbal intelligence and a set of control variables. It shows that, net of the same control variables, more intelligent British teenagers are *not* more likely to prefer vocal music than their less intelligent schoolmates. Once again, consistent with the prediction derived from the Savanna-IQ Interaction Hypothesis, verbal intelligence does not have a significant effect on preference for vocal music ($b = 0.0003$, not significant, beta = 0.0176), nor does any other sociodemographic variable included in the model.

Table 3 presents the analyses of the BCS86 respondents' preference for watching musical programs on TV.[3] Column

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[1] The BCS86 code book and data consistently refer to "electric" music. Because, to our knowledge, there is no genre of music called "electric," we assume that this is a typographical error for "electronic," a genre of music that was particularly popular in the UK in the 1980s.

[2] In the UK, the racial category "Asian" refers almost exclusively to South Asians (chiefly Indian and Pakistani) and usually excludes East Asians (Chinese, Korean, and Japanese), hence the separate category "Chinese" from "Asian." However, there are no Chinese respondents in our sample.

[3] Some of the variables in the two models presented on Table 3, namely West Indian, mixed race, and Jewish dummies for the classical music model, and West Indian dummy in the popular music model, are excluded in order to avoid complete separation (singularities in the Fisher information matrix).

Table 2. Effect of intelligence on preference for instrumental versus vocal music, British Sample (British Cohort Study, 1986 Follow-up)

	(1) Instrumental	(2) Vocal
Verbal intelligence	0.0023**	0.0003
	(0.0008)	(0.0005)
	0.0990	*0.0176*
Academic performance	0.0301***	−0.0059
	(0.0082)	(0.0050)
	0.1303	*−0.0424*
Sex (1 = male)	−0.0234	−0.0082
	(0.0155)	(0.0095)
	−0.0440	*−0.0256*
Race		
Asian	−0.0742	−0.0062
	(0.1074)	(0.0660)
	−0.0286	*−0.0040*
West Indian	−0.0042	0.0559
	(0.2576)	(0.1582)
	−0.0005	*0.0104*
Mixed	−0.1738	0.0517
	(0.1377)	(0.0846)
	−0.0388	*0.0193*
Other	−0.0328	−0.0097
	(0.0491)	(0.0302)
	−0.0195	*−0.0097*
Religion		
Roman Catholic	0.0615	0.0080
	(0.0365)	(0.0224)
	0.0762	*0.0166*
Church of England	0.0203	0.0163
	(0.0307)	(0.0189)
	0.0363	*0.0487*
Other Christian	0.0400	0.0347
	(0.0367)	(0.0225)
	0.0490	*0.0719*
Hindu	0.2435*	0.0273
	(0.1198)	(0.0736)
	0.0767	*0.0144*
Islam	0.1168	0.0022
	(0.1095)	(0.0672)
	0.0368	*0.0012*
Jewish	0.0846	−0.0960
	(0.1841)	(0.1130)
	0.0134	*−0.0254*
Sikh	0.3438**	0.0766
	(0.1310)	(0.0804)
	0.0857	*0.0320*
Other religion	−0.1030	−0.0065
	(0.1091)	(0.0670)
	−0.0281	*−0.0030*
Family income	−0.0025	0.0011
	(0.0034)	(0.0021)
	−0.0246	*0.0182*
Mother's education	0.0020	0.0011
	(0.0043)	(0.0026)
	0.0172	*0.0156*
Father's education	0.0020	−0.0018
	(0.0034)	(0.0021)
	0.0221	*−0.0343*
Constant	−0.3175	0.2722
	(0.0885)	(0.0543)
R^2	0.0619	0.0071
n	1160	1160

Note: "Instrumental" music includes "classical" and "light."
"Vocal" music includes "folk," "disco," "reggae," "soul," "hard rock," "funk," "electronic," "punk," "other," and "pop."
Main entries are unstandardized regression coefficients.
Numbers in parentheses are standard errors.
Numbers in italics are standardized coefficients (betas).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, and **** $p < 0.0001$.

Table 3. Effect of intelligence on watching music programs on TV, British Sample (British Cohort Study, 1986 Follow-up)

	(1) Classical	(2) Pop
Verbal intelligence	0.0276**	−0.0210**
	(0.0092)	(0.0076)
	0.4133	*−0.3146*
Academic performance	−0.0096	0.0245
	(0.0843)	(0.0699)
	−0.0121	*0.0308*
Sex (1 = male)	−.4317**	−.5844****
	(0.1569)	(0.1277)
	−0.2159	*−0.2922*
Race		
Asian	−0.0219	1.3771
	(1.0267)	(0.9937)
	−0.0026	*0.1618*
West Indian	—	—
Mixed	—	0.5626
		(1.2575)
		0.0440
Other	0.2789	0.1623
	(0.4765)	(0.4323)
	0.0485	*0.0282*
Religion		
Roman Catholic	0.5979	0.3191
	(0.3880)	(0.3050)
	0.2075	*0.1108*
Church of England	0.3194	0.1661
	(0.3458)	(0.2502)
	0.1536	*0.0799*
Other Christian	0.5575	−0.0244
	(0.3926)	(0.2975)
	0.1754	*−0.0077*
Hindu	−0.0427	−0.5179
	(1.3749)	(1.0258)
	−0.0039	*−0.0478*
Islam	0.7902	−1.3520
	(1.0307)	(0.8698)
	0.0909	*−0.1555*
Jewish	—	−1.6356
		(1.3654)
		−0.1130
Sikh	3.1003**	0.4968
	(1.1341)	(1.2579)
	0.2514	*0.0403*
Other religion	−0.0426	0.0340
	(1.1583)	(0.9048)
	−0.0035	*0.0028*
Family income	0.0095	0.0132
	(0.0331)	(0.0284)
	0.0237	*0.0328*
Mother's education	0.0034	−0.0235
	(0.0401)	(0.0343)
	0.0079	*−0.0543*
Father's education	0.0080	−0.0132
	(0.0305)	(0.0266)
	0.0224	*−0.0367*
Threshold [$Y = 1$]	4.6036	−5.5753
	(0.9483)	(0.7894)
Threshold [$Y = 2$]	6.8192	−3.3012
	(0.9667)	(0.7748)
χ^2 goodness of fit	2170.4309	2125.5258
−2LogLikelihood	1286.6756*	1719.1149***
Cox and Snell pseudo R^2	0.0296	0.0404
n	1138	1126

Main entries are unstandardized regression coefficients.
Numbers in parentheses are standard errors.
Numbers in italics are standardized coefficients ($b_x s_x$).
Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, and **** $p < 0.0001$.

(1) presents the result of the ordinal regression analysis where BCS86 respondents' frequency of watching classical music TV shows is regressed on their verbal intelligence and

DOI: 10.1002/bdm

a set of control variables. Despite the fact that less intelligent individuals may enjoy watching TV in general more than more intelligent individuals (Kanazawa, 2006), *more* intelligent British teenagers watch classical music on TV more frequently than their less intelligent counterparts. Net of the same sociodemographic variables as before, verbal intelligence has a significantly positive effect on the frequency of watching classical music TV programs ($b = 0.0276$, $p < 0.01$, beta = 0.4133); its effect size, measured by x-standardized regression coefficient (0.4133), is larger than that of any other variable included in the model. Sex and the Sikh religion are the only other variables included in the model that have significant effects; girls watch classical music programs on TV significantly more frequently than boys ($b = -0.4109$, $p < 0.01$, beta = −0.2054), and Sikhs watch them significantly more frequently than atheists ($b = 3.1003$, $p < 0.01$, beta = 0.2514).

Table 3, Column (2), presents the result of the ordinal regression analysis where BCS86 respondents' frequency of watching pop music TV shows is regressed on their verbal intelligence and a set of control variables. It shows that, consistent with the earlier findings with an American sample (Kanazawa, 2006), *less* intelligent British teenagers watch popular music on TV more frequently than their more intelligent counterparts. Net of the same sociodemographic variables as before, verbal intelligence has a significantly *negative* effect on the frequency of watching popular music TV programs ($b = -0.0210$, $p < 0.01$, beta = −0.3146). Sex is the only other variable included in the model that has a significant effect; once again, girls watch popular music programs on TV significantly more frequently than boys ($b = -0.5904$, $p < 0.0001$, beta = −0.2952). It is interesting to note that verbal intelligence has the opposite effects on the frequency of watching classical and popular music programs on TV, whereas sex has the same effect on both. The analysis of the BCS86 data presented in Tables 2 and 3 is consistent with the results from the American sample presented in Table 1 and supports the prediction of the Savanna-IQ Interaction Hypothesis that more intelligent individuals are more likely to prefer (evolutionarily novel) instrumental music, whereas intelligence has no effect on preference for (evolutionarily familiar) vocal music.

For illustrative purposes, Figure 1 presents the mean IQ of GSS respondents by their preference for classical music. It shows that there is a clear monotonic relationship between IQ and preference for classical music in the American sample. GSS respondents who like classical music very much ($n = 170$) have a mean IQ of 107, those who like it ($n = 307$) have a mean IQ of 103, those who have mixed feelings about it (neither like it or dislike it) ($n = 240$) have a mean IQ of 101, those who dislike it ($n = 163$) have a mean IQ of 95, and those who dislike it very much ($n = 91$) have a mean IQ of 93. The association between IQ and preference for classical music is highly significant ($F(4, 966) = 22.6970$, $p < 0.00001$, $\eta^2 = 0.0859$).

Similarly, Figure 2 presents the mean IQ of BCS86 respondents by their preference for classical music. It shows that the mean IQ of those who “usually listen to classical music” ($n = 661$) is 107, whereas that among those who do not usually listen to classical music ($n = 5000$) is 100. The mean difference between the two groups of British teenagers is highly statistically significant ($t(5659) = 11.8270$, $p < 0.00001$).

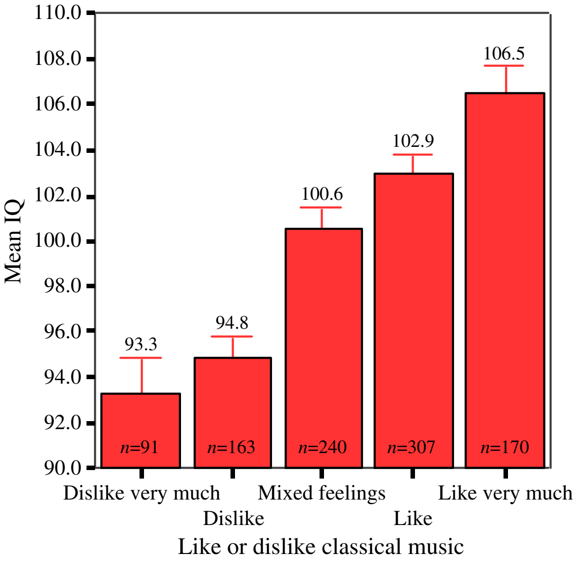

Figure 1. Mean IQ by preference for classical music (U.S. General Social Survey, 1993). *Note*: Error bars represent the standard error for the mean

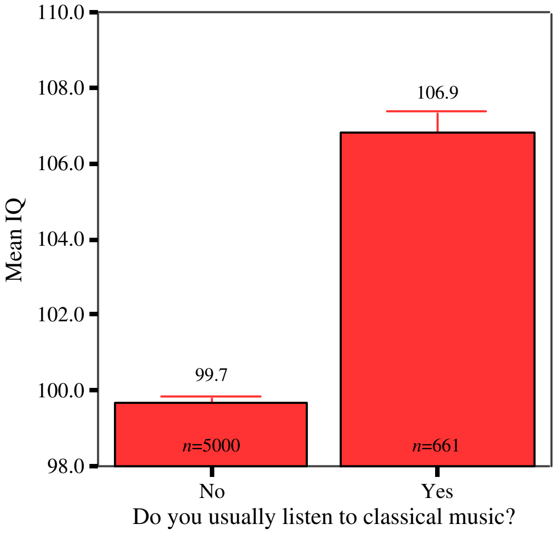

Figure 2. Mean IQ by preference for classical music (British Cohort Study, 1986 Follow-up). *Note*: Error bars represent the standard error for the mean

COGNITIVE COMPLEXITY OR EVOLUTIONARY NOVELTY?

One possible objection to our theory and empirical analyses above is that our dimension of evolutionary novelty, captured by the distinction between instrumental and vocal music, is confounded with cognitive complexity of music. For example, classical music, which is largely instrumental,

DOI: 10.1002/bdm

is also cognitively complex; it is probably the most cognitively complex form of music in human history. On the other extreme, rap music, which is largely vocal, often to the exclusion of any discernible melodic structure, is also cognitively very simple. So critics may argue that the association between intelligence and preference for instrumental music that we demonstrate above is really an association between intelligence and cognitively complex forms of music. Research on "need for cognition" (Cacioppo & Petty, 1982) may lead one to expect such an association, although it is not clear whether need for cognition is strongly correlated with general intelligence (Bors, Vigneau, & Lalande, 2006; Cacioppo, Petty, Feinstein, & Jarvis, 1996; Fleischhauer et al., 2010).

In order properly to test this alternative hypothesis, we would ideally need a quantitative "cognitive complexity score" for each genre of music, in the form (classical = 5, jazz = 4.5, etc.). Further, such "cognitive complexity scores" would ideally have been validated and widely in use. We searched the literature extensively, and consulted several experts in music perception, but have not been able to locate such "cognitive complexity scores" for different musical genres. They just do not seem to exist. Yet, most people seem to understand and agree intuitively that, for example, classical music and jazz are far more cognitively complex than, say, rap music. In the absence of quantitative and validated "cognitive complexity scores," we must rely on such intuitive senses of cognitive complexity of musical genres.

In our empirical exploration, we have chosen to inspect the correlation between intelligence and preference for each genre of music. Because the GSS 1993 data contain a larger number of musical genres than the BCS86 data (18 vs 12) and measure preference more precisely (five-point ordinal scale vs binary), we use the GSS 1993 data to test the alternative hypothesis. Using the BCS86 data produces substantively identical conclusions, however.

A potential problem with inspecting the correlation between intelligence and preference for a specific musical genre is that preferences for all musical genres are very highly correlated. It appears that there are people who like music, and there are those who do not, and those who like music like all types of music. For example, preference for classical music is positively and significantly correlated with preference for both bluegrass and reggae music; in fact, it is significantly positively correlated with preference for 12 of the 18 genres of music. A factor analysis shows that preferences for all 18 genres load on a single latent dimension with positive loadings. We therefore regress intelligence on preferences for all 18 musical genres simultaneously to examine the partial correlation between intelligence and preference for a given genre while holding constant preferences for all other genres.

Table 4, Column (1), presents the partial correlations between intelligence and preferences for all 18 musical genres. As suspected, preference for classical music is significantly positively correlated with intelligence. However, preference for big band is even more strongly positively correlated with it. It would be difficult to make the case that big band music is more cognitively complex than classical music. On the other extreme, as suspected, preference for rap music is significantly negatively correlated with intelligence.

Table 4. Partial correlations between preferences for different music genres and intelligence, American Sample (General Social Survey, 1993)

	(1)	(2)
Genre	No controls	With controls
Big band	2.1172**	1.7627**
	(0.6437)	(0.6194)
	0.1602	*0.1366*
Blues or R&B	0.1512	0.2667
	(0.6941)	(0.6581)
	0.0108	*0.0191*
Bluegrass	0.8014	1.3425
	(0.7253)	(0.6898)
	0.0566	*0.0975*
Classical	1.8384**	1.0108
	(0.6458)	(0.6204)
	0.1540	*0.0860*
Contemporary rock	–0.0953	–0.3574
	(0.6695)	(0.6331)
	–0.0073	*–0.0282*
Country western	–1.8759**	–1.4840**
	(0.5774)	(0.5481)
	–0.1471	*–0.1193*
Folk	0.6612	–0.1889
	(0.6773)	(0.6510)
	0.0474	*–0.0138*
Gospel	–2.4617****	–1.3751*
	(0.5766)	(0.5936)
	–0.1855	*–0.1052*
Heavy metal	–1.0502	–.1109
	(0.5478)	(0.5433)
	–0.0861	*–0.0091*
Jazz	–0.1418	–0.2620
	(0.6657)	(0.6493)
	–0.0107	*–0.0199*
Latin	0.1557	0.1534
	(0.6505)	(0.6236)
	0.0113	*0.0113*
Easy listening	–1.4360*	–1.6884**
	(0.6119)	(0.5840)
	–0.1060	*–0.1280*
Broadway musicals	0.8913	0.2417
	(0.6444)	(0.6448)
	0.0673	*0.0185*
New age	0.6979	0.3228
	(0.5711)	(0.5381)
	0.0548	*0.0258*
Oldies	1.1830	1.4068*
	(0.6670)	(0.6402)
	0.0834	*0.1010*
Opera	0.8213	0.5876
	(0.6562)	(0.6220)
	0.0628	*0.0457*
Rap	–2.1328***	–1.0121
	(0.5839)	(0.5602)
	–0.1662	*–0.0796*
Reggae	0.9920	0.6675
	(0.6025)	(0.5668)
	0.0808	*0.0548*
Constant	96.6085	66.6978
	(3.7340)	(5.4398)
R^2	0.2581	0.4100
n	564	517

Note: Control variables included in Model (2) are age, race, sex, education, family income, religion, whether currently married, whether ever married, and number of children.
Main entries are unstandardized regression coefficients.
Numbers in parentheses are standard errors.
Numbers in italics are standardized coefficients (betas).
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, and **** $p < 0.0001$.

However, preference for gospel music is even more strongly negatively correlated with it. It would be difficult to make the case that gospel is less cognitively complex than rap. (We might point out that, with its close link to religious rituals, gospel is a particularly evolutionarily familiar form of music [Mithen, 2005].) At the same time, preference for opera, another highly cognitively complex form of music, is not significantly correlated with intelligence. Its nonsignificantly positive correlation is smaller than those for oldies, reggae, or Broadway musicals. It would be difficult to make the case that oldies, reggae, or Broadway musicals are cognitively more complex than opera.

Table 4, Column (2), presents the model that also includes the same control variables included in the earlier analysis of the GSS data (age, race, sex, education, family income, religion, whether currently married, whether ever married, and number of children). When these additional controls are included in the model, the partial positive correlation between preference for classical music and intelligence is no longer statistically significant, whereas the partial correlation between preference for big band and intelligence remains statistically significantly positive. With the additional controls, the partial correlation for oldies is now statistically significantly positive. It would be very difficult to make the case that oldies are cognitively more complex than classical music. Rentfrow and Gosling (2003, p. 1241) categorize blues, jazz, classical, and folk music as "structurally complex," but the results presented in Table 4, Column (2), show that none of these genres are significantly correlated with intelligence. Two of the genres (folk and jazz) are nonsignificantly *negatively* correlated with intelligence. All in all, the analysis presented in Table 4 provides little support for the view that more intelligent individuals necessarily and uniformly prefer cognitively complex genres of music.

Given that we do not have quantitative and validated "cognitive complexity scores" for different musical genres, our conclusion in this section must remain tentative. Once such "cognitively complex scores" are constructed and validated, we will need to revisit the issue of the association between general intelligence and preference for cognitively complex music to see if such an association indeed exists. Our preliminary analysis suggests, however, that, unless it turns out that oldies and big band music are cognitively more complex than classical music and jazz, more intelligent individuals may not necessarily prefer cognitively complex music.

DISCUSSION

The Savanna-IQ Interaction Hypothesis, derived from a logical conjunction of the Savanna Principle and a theory of the evolution of general intelligence, suggests that more intelligent individuals may be more likely to acquire and espouse evolutionarily novel values and preferences than less intelligent individuals, whereas general intelligence may have no effect on the acquisition and espousal of evolutionarily familiar values and preferences. An earlier study (Kanazawa, 2010a) has shown that more intelligent individuals are more likely to be liberal and atheist, and more intelligent men (but not women) are more likely to value sexual exclusivity, than their less intelligent counterparts, because these values are evolutionarily novel. In this paper, we have extended the Hypothesis to musical tastes and preferences.

A recent theory of the evolution of music (Mithen, 2005) proposes that music and language may have a common precursor in a holistic, manipulative, multimodal, musical, and mimetic system of communication. If both language and music evolved out of song-like utterances with emotional contents, as Mithen argues, then it follows that music in its evolutionary origin was always vocal and purely instrumental music is evolutionarily novel. If Mithen is right, then the Savanna-IQ Interaction Hypothesis would suggest that more intelligent individuals are more likely to acquire a taste and preference for purely instrumental music, such as big band, classical, and easy listening, but general intelligence has no effect on the acquisition of taste for vocal music.

Our analyses of an American sample (1993 General Social Survey) and a British sample (1986 follow-up of the British Cohort Study) show that more intelligent individuals are indeed more likely to prefer purely or largely instrumental music than less intelligent individuals, whereas intelligence has no effect on preference for purely or largely vocal music. More intelligent British teenagers watch classical music TV programs more frequently than their less intelligent classmates. Additional analyses provide little support for the alternative hypothesis that more intelligent individuals prefer cognitively more complex forms of music.

It is important to point out that, in every regression model, we control for the respondent's social class and education (by teacher-rated academic performance in the case of the BCS86 respondents, all of whom are still in school and thus have the same number of years of formal schooling). Although education has an independent partial effect on musical preference among both American and British respondents, the significant effect of intelligence remains. In no case does the respondent's social class (measured by annual family income and parents' education) have a significant effect on musical tastes. The significant effect of intelligence is not confounded by education or social class.

There are alternative explanations for the association between general intelligence and the preference for instrumental music. For example, individuals may want to signal their intelligence by publicly expressing their preferences for such evolutionarily novel, instrumental music as classical or jazz. However, such an explanation based on signaling does not explain *why* certain genres of music (such as classical or jazz) have come to be associated with higher intelligence. Why do intelligent individuals not signal their intelligence by publicly expressing their preference for country western or gospel music? The Savanna-IQ Interaction Hypothesis can simultaneously explain the origin of the association between intelligence and certain genres of music and suggest that there may be empirical basis for the "stereotype" that intelligent individuals listen to classical or jazz music. Once the association between intelligence and preference for instrumental music is widely known, however, costly signaling may explain individuals' *motivation* to cultivate such preference as a signal for their intelligence.

It is important to note that, although the theory of the evolution of general intelligence (Kanazawa, 2004b, 2008) proposes that general intelligence originally evolved to solve evolutionarily novel and nonrecurrent adaptive problems, the Savanna-IQ Interaction Hypothesis (Kanazawa, 2010a) does *not* suggest that evolutionarily novel preferences and values that more intelligent individuals are more likely to acquire and espouse are necessarily adaptive and increase their reproductive success in the current environment. It is not obvious how being a left-wing liberal or atheist (Kanazawa, 2010a) or being nocturnal (Kanazawa & Perina, 2009) increases reproductive success today. And some of the evolutionarily novel preferences that more intelligent individuals are more likely to acquire and espouse, such as the consumption of alcohol, tobacco, and psychoactive drugs (Kanazawa & Hellberg, 2010), are manifestly detrimental to health and survival. The Savanna-IQ Interaction Hypothesis does not predict that more intelligent individuals are more likely to acquire and espouse healthy and adaptive preferences and values, only evolutionarily novel ones.

ACKNOWLEDGEMENTS

We thank Jay Belsky, Tomas Chamorro-Premuzic, Daniel Levitin, Nando Pelusi, Brent T. Simpson, and David Temperley for their comments on earlier drafts and other contributions.

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DOI: 10.1002/bdm