The Sound of Intelligence

Daniela Panait[*iv], Monica-Iuliana Popescu[*], Livica Frăţiman[*]

[*] Faculty of Psychosociology, Psychology Department,
„Andrei Şaguna" University, Constanţa, Romania

Abstract

Introduction: *Music has a special place in human activity due to its antiquity and ubiquity. No culture is without music and as evidence, some of the oldest archaeological relics found are musical instruments. On one hand, many music lovers admit that they know nothing about it, but they enjoy it. On the other hand, if we all like music, how can we explain the differences between people's musical preferences? Are these preferences influenced by the previous accumulated knowledge which has in the cultural context?*

Objective: *This research aims to investigate a link between musical preferences and the crystallized intelligence component, which is heavily dependent on the cultural aspects and also to answer the question why people seem to settle in their tastes of music as they get older.*

Methods: *The Intelligence Structure Test (I-S-T 2000R) was applied to 100 subjects (64 women and 36 men) and also, two questionnaires have been applied, which aimed to investigate the musical preferences of the study's participants. The first questionnaire contains questions about musical preferences, while the second one has an audio file attached , which contains fragments of different musical genres.*

Results: *After statistically processing the collected data, it has been showed that the participants who scored above average at the Intelligence Structure Test prefer mostly to listen to classical and rock music, while those with a lower score listen to commercial and rhythmic music.*

Conclusions: *The study indicates links between musical preferences and crystallized intelligence – the culture's reflection over the structure of intelligence.*

Keywords: crystallized intelligence, intelligence structure, culture, muzical preferences

[iv] Corresponding author: Daniela Panait, Faculty of Psychosociology, „Andrei Şaguna" University, Alexandru Lăpuşneanu Boulevard 13, 900196, Constanţa, Romania. Email: danie.panait@gmail.com.

I. Introduction

Intelligence

In the study of human intelligence, probably all answers are not able to define intelligence, perhaps, because it can be seen from many points of view and no one can state its object. Sternberg tried to systematize it in seven metaphors: geographical, numerical, biological, epistemological, sociological, anthropological and systematic (Sternberg, 1990). But his study did not start here and not the psychologists nor the educators were the first who studied its nature, but philosophers. Studied for thousands of years, the most relevant information was discovered in the late 19th century. The modern theories are based on the identification of general intellectual "skills" which are supposed to form the basis of all individual's actions.

The natural questions which arise with respect to intelligence are: is it originated in our genetic code or influenced by the environment? What form does it take? It increases or decreases as we aged or from a generation to another? Does it matter in everyday life? (Deary I. J., 2008)

Cattell divided intelligence into two constructs: *fluid intelligence* (gf) and *crystallized intelligence* (gc) (Cattell, 1963; Cattell, R. B., 1987), and recent studies have confirmed this classification (Carroll, 1993; Staudinger, Maciel, Smith, & Baltes, 1998).

For this study, only the *crystallized intelligence* will have an important significance. Moreover, "the construct *gc* is manifested by the accumulated knowledge and ability to think logically using concepts that have been learned (such as general knowledge, meaning of words or arithmetic)" (Liepmann, Broke, Beauducel, & Amthaner, 2011, p. 11). Compared to *fluid intelligence* (which refers to the ability to solve abstract problems using inductive reasoning to understand previously unknown relationships between variables), *crystallized intelligence* depends on the prior acquired knowledge involved in understanding or solving problems and has its roots in the cultural context.

Recent research (Deary, Whaley, Lemmon, Crawford, & Starr, 2000) concluded that there is a substantial stability of intelligence throughout life, but there might be substantial changes related to external factors such as education, health and many others.

Musical preferences

Edgar Varčse defined music as an "organized sound", a "melodic tonality" (Denizeau, 2000, p. 234). Sartre saw music as "a pure image that appears in the sounds" (Iamandescu, 2011, p. 6), while for Emil Cioran it was "the absolute lived, lived, however, through an enormous delusion because it vanishes as soon as peace is restored" (Cioran, 2000, p. 14). In the Romanian Explanatory Dictionary (DEX, 2012) music is defined as: "*1. Art to express feelings and ideas combined with sounds in a specific manner. 2. The science of the sounds considered in terms of melody, rhythm and harmony."* For some, music means Beethoven, Mozart, and Vivaldi, jazz or tango, while for others, music is Madonna, Bob Dylan, and Led Zeppelin. For each of us, music means something else.

As we could see, music is perceived differently by each person because the sounds are not perceived directly by the brain. Firstly, the ciliated cells contained in the basilar membrane of the ear reacts to the sound, and they do this in a different way. These cells trigger various electrical impulses in response to what they perceive: lower sounds excite the cells from one end of the membrane, the average ones the middle and the high ones the other end (Levitin, 2013, p. 35). The brain builds its own version of the music interpretation and is based partly on what exists in reality. It builds and skillfully combines musical tones already learned.

Musical preferences and Intelligence

After trying to define intelligence on one hand and music on the other hand, the trivial question may arise: is there a relationship between musical preferences and the crystalized intelligence?

Studies related to musical preferences and general intelligence were not many. Among them, the research performed by the PhD student at that time, Virgil Griffith, is the most relevant. According to him (Griffith, 2009), comparing school performance obtained at SAT exams and the music listened by the subjects, the students with best results listen primarily to classical music, those with high intellectual performances are fans of Radiohead, U2, Bob Dylan (i.e., mostly listeners of rock music), and those with medium and above intellectual capacities listen to Queen, The Beatles, Jimi Hendrix, Franck Sinatra or Bob Marley. A special category is that of the least intellectually gifted individuals who listen to commercial music (pop, commercial rap/hip-hop etc.).

In 2007, a Romanian consultancy company conducted a public survey on identifying the Romanians' musical preferences and their listening habits (Deadalus, 2007).

They concluded that Romanians listen mostly to foreign music rather than autochthonous music, and elderly persons and those with a lower education level prefer music with Romanian lyrics. Slow music, dance, folk and house are the genres most

listened to. On the other hand, ”manele”, ”populara” and rap/hip-hop music are liked by people with lower levels of education.

A recent study (Kanazawa & Perina, 2012) suggests that individuals with high intellectual abilities are more likely to acquire and embrace the new evolutionary values and preferences, while the less intelligent do not.

The hypothesis implies that more intelligent individuals prefer purely instrumental music, while those less gifted prefer the vocal predominant music. Additional analysis suggested that the effect of intelligence on musical preferences is not directly related to the cognitive musical complexity.

II. Methods

Objectives

This research aims to investigate a link between musical preferences and crystallized intelligence, which is heavily dependent on the cultural aspect and also, to answer the question why people seem to settle in their tastes for music as they get older.

The hypotheses we elaborated in order to reach our objectives are as follows:

1. We assumed that the individuals with a crystalized intelligence IQ above average listen mostly to classical and rock music and those with medium and lower IQ listen to more commercial music.

2. We assumed that individuals tend to stabilize in their musical preferences.

Study participants. To achieve the objectives and to test the hypotheses, 100 subjects (64 women and 36 men) were included in the study. The subjects were aged between 14 and 74 years old, and the gender distribution is shown in the following association table.

Table 1. Gender/age association table

Age Groups	Male	Female	Total
1 14-24 years	7	5	12
2 25-35 years	8	23	31
3 36-65 years	21	36	57
Total	36	64	100

Instruments

Three instruments were used:

1. The I-S-T 2000R: Intelligenz-Strucktur-Test 2000R – which measures not only the fluid intelligence, but also the crystallized intelligence. This test can be completed by a person in approximately 144 minutes and it is dived into two main parts:

- the Base Module which measures the verbal, numerical and figural reasoning
- the Extended Module which measures the verbal, numerical and figural knowledge.

The primary factorial level measures the verbal, numerical and figural intelligence as a sum of reasoning, and at its secondary level, with the help of the Extended Module, the fluid and crystalized intelligence.

2. A questionnaire regarding the musical preferences based on a Likert scale from 1 to 5, with 16 items referring to different relevant musical genres.

3. An audio file attached to a similar questionnaire where the subjects were asked to measure on a scale 1-5 the preference for a different genre without its knowing the actual name.

In designing the questionnaires, the study of Rentfrow and Gosling regarding the musical preferences and personality types has been considered (Rentfrow & Gosling, 2006).And also, the study of the same group of authors, in which the Big5 model has been used, has been taken into consideration (Rentfrow, P. J., Goldberg, L. R., Levitin, D. J., 2011).

Procedure and experimental design. The Intelligence Structure Test has been applied and the first questionnaire was given to the subjects. After a period of time the audio file and the second questionnaire have been applied.

By applying the two questionnaires in separate moments, we tried to find out whether the subjects are lying about their musical preferences and are trying to give a positive impression about this or not. No reference of how the testes are scored was given to the audience.

In the first questionnaire the 16 musical genders were randomized and the subjects were asked to express their preference regarding the genres with a score from 1 to 5 (1 – I do not like it at all; 5 – I like it very much). The genres were in the following order:

Classical, Classical Rock, Pop, Heavy metal, Rap/Hip-hop, Blues/ Soul/ R'n'B, Ușoara, Alternative Rock/ Progressive Rock, Reggae, Folk, Crossover, Neo-classical, Trap/DubStep, Jazz, Latino, House.

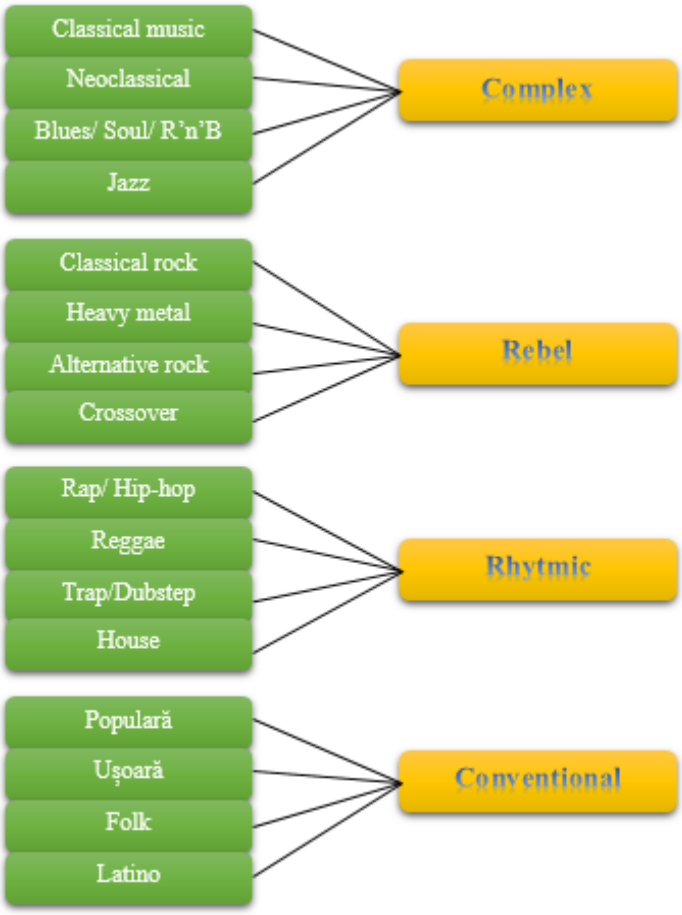

Figure 1. Musical preferences categories

In the second questionnaire, the musical genres were not named and in exchange an audio file containing fragments of the same musical genres as in the first questionnaire was provided and the subjects were asked again to score them from 1 to 5. This time, the musical fragments were assembled in a specific order in 4 main groups, but these groups were known only by the researchers and were not revealed to the subjects. The musical fragments were played with a pause of 5 seconds in between. The groups were designed after Rentfrow et al. main's design (Rentfrow, P. J.; Gosling, S. D., 2003; Rentfrow, P. J.; Goldberg, L. R.; Levitin, D. J.;, 2011), and has been adapted on Romanian musical preferences. These categories are shown in *Figure 1.*

Initially, the tests contained the musical genre called "Manele", but everyone marked this genre with 1, so we decided to exclude it from the following questionnaires. The sum of the subjects' scores on the classified groups known only by the researches were compared between the two questionnaires and so, the musical preference was obtained.

III. Results

To test the first hypothesis, where a significant correlation between the musical preferences and the crystalized intelligence IQ scores is presumed, the following steps were followed:

Table 2. The Kolmogorov-Smirnov normality test results

One-Sample Kolmogorov-Smirnov Test

		Crystallized intelligence
N		100
Normal Parameters[a,b]	Mean	110,07
	Std. Deviation	16,235
Most Extreme Differences	Absolute	,047
	Positive	,047
	Negative	-,035
Kolmogorov-Smirnov Z		,475
Asymp. Sig. (2-tailed)		,978

a. Test distribution is Normal.

b. Calculated from data.

Checking the normality of the IQ scores distribution, using both the Kolmogorov-Smirnov Test and the Skewness and Kurtosis analysis, we concluded that the distribution is normal. The gross data of our sample split into categories referring to their intelligence and their musical preferences is given below. The categories used to classify the IQ scores were based on the Wechsler scale (Wechsler, D., 1997).

Table 3. Crystalized Intelligence IQ/ Musical preferences association table

	Structure				
	Complex	Rebel	Rithmic	Conventional	Total
130+ exceptional	4	6	0	1	11
120-129 superior	11	3	2	0	16
110-119 above average	4	2	14	6	26
90-109 average	1	3	16	14	34
80-89 below average	0	0	4	8	12
70-79 border	0	0	0	1	1
Total	20	14	36	30	100

However, the data grouped as follows has not lead us to any conclusion to meet our hypothesis. In order to acquire the best results we agglutinated the data, therefore we have divided the data into three main categories according to the subjects' IQ scores: superior + (above average, superior and exceptional), average, and average – (below average and border). This data is presented in *Table 4.*

Table 4. Crystalized Intelligence IQ/ Musical preferences for agglutinated data

			Music				
			1 Complex	2 Rebel	3 Rhytmic	4 Conventional	Total
IQStructureGC	1 superior + (110+)	Count	19	11	15	7	52
		Expected Count	10,4	7,3	18,7	15,6	52,0
		% within IQStructureGC	36,5%	21,2%	28,8%	13,5%	100,0%
		% within Music	95,0%	78,6%	41,7%	23,3%	52,0%
	2 average (90-109)	Count	1	3	17	14	35
		Expected Count	7,0	4,9	12,6	10,5	35,0
		% within IQStructureGC	2,9%	8,6%	48,6%	40,0%	100,0%
		% within Music	5,0%	21,4%	47,2%	46,7%	35,0%
	3 average - (89 -)	Count	0	0	4	9	13
		Expected Count	2,6	1,8	4,7	3,9	13,0
		% within IQStructureGC	0,0%	0,0%	30,8%	69,2%	100,0%
		% within Music	0,0%	0,0%	11,1%	30,0%	13,0%
Total		Count	20	14	36	30	100
		Expected Count	20,0	14,0	36,0	30,0	100,0
		% within IQStructureGC	20,0%	14,0%	36,0%	30,0%	100,0%
		% within Music	100,0%	100,0%	100,0%	100,0%	100,0%

Analyzing the data in the above table, and also, the *Chi-square* test applied where $(\chi^2 = 34.26, df = 6, p = 0.000)$, has lead us to the affirmation that the two variables are roughly linked. As expected, the individuals with high IQ scores tend to listen to more complex and rebel music, while, on the other side, as the IQ lowers, individuals tend to listen to more energetic and conventional music. To find the strength of the association, the φ *Cramer* (where $\varphi = \sqrt{\chi^2/_N}$) coefficient has been calculated for the association table, thus $\varphi = 0.41$, which is greater than 0.40 (Popa, 2008, pp. 192-193), and this means there is a strong association for the 100-subject sample. But, the association also indicates that we cannot say anything about the individuals with average IQ scores.

Furthermore, we have again agglutinated the data into two categories as follows: average + (IQ scores ≥ 90) and average – (IQ scores < 90). And, for this, the *Chi-squared* test $(\chi^2 = 12.86, df = 3, p = 0.005)$ and also, $\varphi = 0.35$ pointed out a medium to strong association.

Table 5. Above average and below average IQ scores/ Musical preferences for agglutinated data

			Music				
			1 Complex	2 Rebel	3 Rhytmic	4 Conventional	Total
StructureIQ2	1 average +	Count	20	14	32	21	87
		Expected Count	17,4	12,2	31,3	26,1	87,0
		% within StructureIQ2	23,0%	16,1%	36,8%	24,1%	100,0%
		% within Music	100,0%	100,0%	88,9%	70,0%	87,0%
		Residual	2,6	1,8	,7	-5,1	
	2 average -	Count	0	0	4	9	13
		Expected Count	2,6	1,8	4,7	3,9	13,0
		% within StructureIQ2	0,0%	0,0%	30,8%	69,2%	100,0%
		% within Music	0,0%	0,0%	11,1%	30,0%	13,0%
		Residual	-2,6	-1,8	-,7	5,1	
Total		Count	20	14	36	30	100
		Expected Count	20,0	14,0	36,0	30,0	100,0
		% within StructureIQ2	20,0%	14,0%	36,0%	30,0%	100,0%
		% within Music	100,0%	100,0%	100,0%	100,0%	100,0%

According to the I-S-T Manual (Liepmann, Broke, Beauducel, & Amthaner, 2011), an average intelligence is at a score of 100, thus a further analysis has been made by splitting the data into two parts: above average (100+) and below average (100-). The *Chi-squared* test indicated $(\chi^2 = 18.77, df = 3, p = 0.000)$ also a strong association of $\varphi = 0.43$.

Table 6. Above average and below average IQ scores based on I-S-T/ Musical preferences

			Music1				
			1 Complex	2 Rebel	3 Rhytmic	4 Conventional	Total
IQgcIST	1 100+	Count	21	13	22	15	71
		Expected Count	14,9	9,9	25,6	20,6	71,0
		% within IQgcIST	29,6%	18,3%	31,0%	21,1%	100,0%
		% within Music1	100,0%	92,9%	61,1%	51,7%	71,0%
	2 100-	Count	0	1	14	14	29
		Expected Count	6,1	4,1	10,4	8,4	29,0
		% within IQgcIST	0,0%	3,4%	48,3%	48,3%	100,0%
		% within Music1	0,0%	7,1%	38,9%	48,3%	29,0%
Total		Count	21	14	36	29	100
		Expected Count	21,0	14,0	36,0	29,0	100,0
		% within IQgcIST	21,0%	14,0%	36,0%	29,0%	100,0%
		% within Music1	100,0%	100,0%	100,0%	100,0%	100,0%

We developed our research, as we had also combined the musical categories from four to two as follows: complex and rebel, rhythmic and conventional. The results are as follows. By applying the *Chi-square* test the following data were obtained $(\chi^2 = 27.062, df = 2, p = 0.000)$.

Combining all the data as we had above, for the 2×2 association tables, we acquired for the *Chi-square* test $(\chi^2 = 8.405, df = 1, p = 0.004)$ and for the *Fisher's Exact* test a *p* value of *.004* which is less than *.05*, which confirms the assumptions.

And for the last association table, the *Chi-square* test states $(\chi^2 = 15.016, df = 1, p = 0.000)$ with a medium to strong effect $\varphi = 0.39$ and a *Fisher's Exact* test lower than *.05*.

Table 7. Agglutinated data both for Intelligence and Music test results

			Music2		
			1 Complex+Rebel	2 Rhytmic+Conventional	Total
StructureIQ1	1 superior + (110+)	Count	31	21	52
		Expected Count	18,7	33,3	52,0
		% within StructureIQ1	59,6%	40,4%	100,0%
		% within Music2	86,1%	32,8%	52,0%
	2 average (90-109)	Count	5	30	35
		Expected Count	12,6	22,4	35,0
		% within StructureIQ1	14,3%	85,7%	100,0%
		% within Music2	13,9%	46,9%	35,0%
	3 average - (89 -)	Count	0	13	13
		Expected Count	4,7	8,3	13,0
		% within StructureIQ1	0,0%	100,0%	100,0%
		% within Music2	0,0%	20,3%	13,0%
Total		Count	36	64	100
		Expected Count	36,0	64,0	100,0
		% within StructureIQ1	36,0%	64,0%	100,0%
		% within Music2	100,0%	100,0%	100,0%

			Music2		
			1 Complex+Rebel	2 Rhytmic+Conventional	Total
StructureIQ2	1 average +	Count	36	51	87
		Expected Count	31,3	55,7	87,0
		% within StructureIQ2	41,4%	58,6%	100,0%
		% within Music2	100,0%	79,7%	87,0%
	2 average -	Count	0	13	13
		Expected Count	4,7	8,3	13,0
		% within StructureIQ2	0,0%	100,0%	100,0%
		% within Music2	0,0%	20,3%	13,0%
Total		Count	36	64	100
		Expected Count	36,0	64,0	100,0
		% within StructureIQ2	36,0%	64,0%	100,0%
		% within Music2	100,0%	100,0%	100,0%

			Music2		
			1 Complex+Rebel	2 Rhytmic+Conventional	Total
IQgcIST	1 100+	Count	34	37	71
		Expected Count	25,6	45,4	71,0
		% within IQgcIST	47,9%	52,1%	100,0%
		% within Music2	94,4%	57,8%	71,0%
	2 100-	Count	2	27	29
		Expected Count	10,4	18,6	29,0
		% within IQgcIST	6,9%	93,1%	100,0%
		% within Music2	5,6%	42,2%	29,0%
Total		Count	36	64	100
		Expected Count	36,0	64,0	100,0
		% within IQgcIST	36,0%	64,0%	100,0%
		% within Music2	100,0%	100,0%	100,0%

To verify the second hypothesis, which assumed that people tend to stabilize in their musical preferences, a qualitative analysis has been done. The individuals have been distributed into groups as seen in the following charts. The groups were formed based on both the developmental psychology theory (Verza, 1993) and also on our own classification.

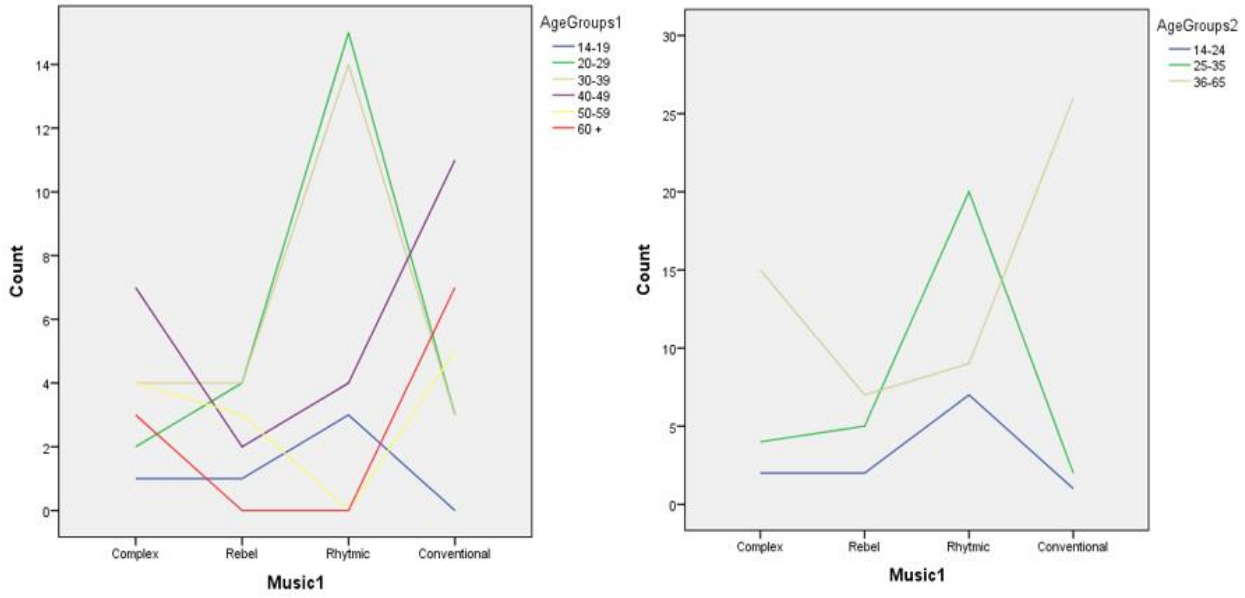

Figure 2. Age based musical preferences

According to the charts, we can observe the peaks at Rhythmic musical preferences for individuals aged between 14 and 39 years old. We can conclude that teenagers and young adults like more rhythmical music, while the others converge to the extremes, meaning Complex and Conventional music. As we can see, adults (aged 40 +) listen more to Complex and Conventional music, showing lower levels on Rebel and Rhythmic music.

IV. Conclusions

The main conclusion drawn from this study is that the research met its objectives and the hypotheses were confirmed. The study indicates links between musical preferences and crystallized intelligence - intelligence structure reflection on culture.

Individuals with above average scores at the Intelligence Structure Test listen to more complex music, meaning classical music, jazz, blues, soul, R'n'B, all kinds of rock genres, while those with average and low scores have certain affinity for commercial music: pop, latino, hip-hop and also for Romanian traditional music, such as ușoara or populara. We must also take into account the age of the participants, as teenagers and young adults listen to more energetic music and elder people to more complex or more conventional, depending on their IQ level. We conclude that further studies on larger groups would provide more significant data on this matter.

References

Carroll, J.B. (1993). *Human cognitive abilities. A survey of factor-analytical studies.* Cambridge: Cambridge University Press.

Cattell, R B. (1963). Theory of fluid and crystallized intelligence: a critical experiment. *Journal of Educational Psychology, 54*, 1-22.

Cattell, R B. (1987). *Intelligence: Its Structure, Growth and Action.* Amsterdam: Elsevier Science Publishers, B.V.

Cioran, A. (2000). *Cioran and the music.* Bucharest: Humanitas.

Deadalus (2007). *Music.* Bucharest: Deadalus Consulting.

Deary, I.J. (2008). *The intelligence – A very brief introduction.* Bucharest: ALL.

Deary, I.J., Whaley, L.J., Lemmon, J.R., Crawford, J.R., & Starr, J.M. (2000). The Stability of the Individual Distinctions in terms of Mental Ability From Childhood to Old Age: a follow-up of the 1992 Scottish Mental Survey. *Intelligence, 28*, 49-55.

Denizeau, G. (2000). *Understanding and identifying musical genres.* Bucharest:Meridiane.

Griffith, V. (2009). *Musicthatmakesyoudumb*. Retrieved from http://musicthatmakesyoudumb.virgil.gr/

Iamandescu, I.B. (2011). The acquisitive musictherapy. Constanța: „Andrei Șaguna" Foundation.

Kanazawa, S., & Perina, K. (2012). Why More Intelligent Individuals Like Classical Music. *Journal of Behavioral Decision Making, 25*(3), 264-75.

Levitin, D. J. (2013). *Creierul nostru muzical:Știința unei eterne obsesii.* București: Editura Humanitas.

Liepmann, D., Broke, B., Beauducel, A., Amthaner, R. (2011). *I-S-T 200R: The intelligence structure test - Technical manual*. Bucharest: O.S. Romania.

Popa, M. (2008). *Statistics for psychology: theory and SPSS applications.* Bucharest: Polirom.

Rentfrow, P.J., & Gosling, D.S. (2006). Message in a Ballad: The Role of Music Preferences in Interpersonal Perception. *Psychological Science, 17*(3), 236-242.

Rentfrow, P.J.; Goldberg, L.R.; Levitin, D.J. (2011). The Structure of Musical Preferences: A Five-Factor Model. *Journal of Personality and Social Psychology, 100*(6), 1139-1157.

Rentfrow, P.J.; Gosling, S.D. (2003). The Do Re Mi' of Everyday Life: The Structure and Personality Correlates of Music Preferences. *Journal of Personality and Social Psychology, 86*(6), 1236-1256.

Staudinger, U.M., Maciel, A.G., Smith, J., & Baltes, P.B. (1998). What Predicts Wisdom-Related Performance? A first look at Personality, Intelligence and Facilitative Experimental Contexts. *European Journal of Personality, 12*, 1-17.

Sternberg, R.J. (1990). *Metaphors of mind: Conceptions of the nature of intelligence.* New York: Cambridge University Press.

The Romanian Academy (2012). *The explanatory dictionary of the romanian language.* Bucharest: Univers Enciclopedic Gold.

Verza, E. (1993). *Psychology of ages.* Bucharest: Hyperion.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale* - 3rd Ed. (WAIS-III). San Antonio, TX: The Psychological Corporation.