

## **Evaluation of Perceptual Musical Abilities of Early-school Children**

### **Abstract**

The purpose of this article is to present research conducted in Poland enabling the evaluation of the structure and level of perceptual musical abilities of third-grade students finishing their early-school education. The evaluation was based on A. Weiner's Test of Perceptual Musical Abilities which examines important areas of music perception, including the complex structure of the abilities. The research presented herein is unique and the analysis of differences in gender-related results provides essential information on the strong and weak aspects of the skills. The research does not confirm the numerous reports indicating the superiority of girls in music tests.

**Keywords:** *elementary education, perceptual musical abilities of students, gender*

### **Introduction**

Perceptual musical abilities are acquired in the area of sound phenomena, in which learning is related to the formation of concepts based on perceptual experience and thinking in terms of sounds and meanings contained within the structure of music. E.E. Gordon defines this area as audiation (Miklaszewski 1990, pp. 192-194; cf. also Gordon 2001). Perceptual musical skills are essential in music education and can be learned by school children, at least at a good level (Weiner 2010, p. 36).

From birth to about middle childhood, a child raised in European-American culture adopts spontaneously some particular musical abilities in the process of acculturation. The subsequent development of special musical competences takes place in the course of conscious education (Sloboda 2002, pp. 237-238; 262).

The studies conducted by B. Bonna (2005), A. Weiner (2007, 2010) and E. Frołowicz (2012) prove that the level of perceptual musical abilities at the pre-school and early-school ages is not satisfactory. The reasons for this phenomenon should be sought in the weak preparation of kindergarten and early-school teachers to implement music education, the low status of music in schools, as well as the low musical culture of the family environment.

In the standardization of the Test of Perceptual Musical Abilities (TPMA), A. Weiner indicated that gender is a factor which makes a difference in musical competences in favour of girls (Weiner 2007, pp. 73-74). It was not confirmed in other studies by A. Weiner (2010) and E. Frołowicz (2012), even though there were some gender-related differences in some perceptual abilities. The advantage of girls over boys in research on musical development and in most cases associated with music perception is also pointed out by R. Shuther-Dyson and C. Gabriel (as cited in Sloboda 2002, p. 260). Studies conducted under the auspices of the Polish Music Council revealed a similar tendency (cf., Białkowski, Grusiewicz, Michalak, 2010). Moreover, a report recently published in the USA shows that by the eighth grade, girls outperform boys in music test scores (Roulston, Misawa 2011, p. 4).

The research presented hereinafter was based on the recently constructed test, which is particularly important, because until now there have been no standardized methods for measuring musical competences of elementary school students in Poland. Apart from this research, the test was used twice (cf., Weiner 2010, Frołowicz 2012). The research introduces a new approach to music education that combines a multidimensional diagnosis of perceptual musical abilities which worldwide are not evaluated as a whole, because it focuses more on specific aspects of the skills (e.g. style sensitivity, perception of tonality and rhythm, etc.), and their relationships with other factors (cf., Young 1976; Tanner, 1982; Marshall, Shibasaki 2011). The research shows the complex structure as well as the strengths and weaknesses of the abilities, which is important information given the fact that the area of music education is neglected, while these skills prepare children for participation in music culture of high artistic value.

## **Methodology**

The purpose of the research was to diagnose the perceptual musical abilities of third-grade students, define gender-related differences in the study group at the level of competence formation and to compare the test results with the results obtained by other authors.

The main research problem was defined in the course of the study and aimed at answering the following question: What are the structure and the level of perceptual musical abilities of students finishing their early-school education? The main research problem was then divided into the following detailed problems:

1. Is gender a factor differentiating the perception of the constructive elements of a piece of music? If yes, to what extent?
2. Is gender a factor differentiating the perception of identity in musical realization and music style? If yes, to what extent?
3. Is gender a factor differentiating the ability to associate music with non-musical contents and sound sensitivity? If yes, to what extent?

The study used an empirical quantitative strategy based on the method of testing. The quantitative and qualitative analyses and discussion of the results were carried out for a holistic view of the outcome and gender differences. Student t-test and chi-square test were used to compare the two groups. The research tool was TPMA (experimental version), which diagnoses significant areas of music perception and related skills in the following areas: I. Perception of the constructive elements of a musical piece, II. Identity in music, style sensitivity, III. Associating music with non-musical contents, sound sensitivity (Weiner 2007, p. 41). Part I of the test evaluates the perception of elements of the language of music, such as the form AB or ABA and structure elements, including rhythm, melody (realization-changes, character), consonance, dynamics and tempo. Part II of the test makes a diagnosis of the ability to perceive identity in musical realization in the aspect of melodic stability and the perception of style and its characteristic elements, including: folklore, stylizations, national component, historical component and a composer's style. Part III verifies the abilities of identifying music with an image and motion, recognizing timbres of instruments and singing voices and the sound made by a performing band (Weiner 2007, pp. 19, 41).

The research was conducted in the city of Bydgoszcz and the Kuyavian-Pomeranian Province, Poland, in 2006-2011. It involved 473 third-grade students (9-10 years old, 247 girls and 226 boys) in 18 primary schools.

## **Results and discussion**

The analysis presented below first compares the mean results obtained by pupils in particular areas and the entire test, and then individual tasks in each part of TPMA.

### **I. Comparing TPMA mean results – own study**

In the course of the research, the arithmetic means of points obtained by school-children in particular parts as well as the total test result were evaluated.

**Table 1.** Mean results of TPMA in the group of girls and boys

TMUP	Statistics	Girls	Boys	DF	pt
Part I	N	247	226		
	Mean	9.08	9.04	0.04	0.875
	%	56.76	56.50	0.26	
Part II	N	247	226		
	Mean	7.25	6.98	0.27	0.284
	%	51.76	49.84	1.92	
Part III	N	247	226		
	Mean	7.53	7.30	0.23	0.208
	%	62.75	60.84	1.91	
Total result	N	247	226		
	Mean	23.86	23.32	0.54	0.335
	%	56.80	55.52	1.28	

Source: own study

pt – probability resulting from the t-Student test

The analyses showed no statistical differences between the mean results of the boys and girls, though the girls were a bit better in all parts of the test. In both groups, Part II gave the worst, while Part III gave the best results. In Part I, the percentage of correct answers and the total result oscillated around 56%, while in Part III, it was slightly above 60%. In part II, the boys gave more wrong than correct answers, while the girls did the opposite.

Slightly poorer results (54% of correct answers), estimated on the basis of the entire TPMA results given by 1329 third-grade pupils nationwide (test standardisation), were obtained by A. Weiner (2007, p. 73). In the subsequent research con-

ducted by the same author among 223 pupils in the neighbourhood of Lublin, the study group solved a total of almost 52% of tasks (Weiner 2010, p. 213). The poorest results (circa 48% of correct answers) were obtained by E. Frołowicz, who examined 93 primary school pupils in Gdańsk (2012, p. 278). In A. Weiner's research (2010), girls appeared to be better than boys only in Part III of the test, while in E. Frołowicz's (pretest) research (2012), in Parts I and III. Statistical differences between the arithmetical means from the entire test in favour of girls were shown only in the TPMA standardisation studies (Weiner 2007). Among the total number of students in all the reported studies, competences related to tasks diagnosing the perception of identity in musical realization were the poorest (Weiner 2007, 2010; Frołowicz 2012). According to A.J. Sloboda (2002, p. 260), musical training does not affect pupils' results in this area. The abilities diagnosed in Part II of the test are the effect of acculturation and they develop in natural, intellectual contacts of the child with music of the surrounding culture, not depending on specific musical training.

## II. Perception of the constructive elements of a musical piece – own study

Detailed research results relating to Part I of the test are presented in the table below.

**Table 2.** The level of perceptual musical abilities – subtest I

Range	Task number	Items	Girls	Boys	DF	pc2
			%	%	%	
Perception of pitch structures	1	1	58.70	64.60	-5.90	0.188
		2	78.95	74.34	4.61	0.236
		<b>Total</b>	<b>68.83</b>	<b>69.47</b>	<b>-0.64</b>	<b>0.979</b>
	2	1	42.51	42.04	0.47	0.917
		2	53.85	57.96	-4.11	0.368
		<b>Total</b>	<b>48.18</b>	<b>50.00</b>	<b>-1.82</b>	<b>0.385</b>
Repetition of motifs	3	1	78.14	74.78	3.36	0.389
		2	65.99	57.52	8.47	0.058
		<b>Total</b>	<b>72.06</b>	<b>66.15</b>	<b>5.91</b>	<b>0.192</b>
Perception of time structures (metre)	5	1	41.70	43.81	-2.11	0.644
		2	61.54	56.19	5.35	0.238
		<b>Total</b>	<b>51.62</b>	<b>50.00</b>	<b>1.62</b>	<b>0.586</b>
Perception of time structures (tempo)	7	1	68.42	75.66	-7.24	0.080
		2	61.13	61.95	-0.82	0.856
		<b>Total</b>	<b>64.78</b>	<b>68.81</b>	<b>-4.03</b>	<b>0.312</b>

Range	Task number	Items	Girls	Boys	DF	pc2
			%	%	%	
Harmony: a) Tonality	6	1	25.91	38.05	-12.14	<b>0.005</b>
		2	49.39	47.79	1.60	0.727
	<b>Total</b>		<b>37.65</b>	<b>42.92</b>	<b>-5.27</b>	<b>0.274</b>
b) Final tones	8	1	52.23	45.58	6.65	0.148
		2	43.32	43.36	-0.04	0.993
	<b>Total</b>		<b>47.77</b>	<b>44.47</b>	<b>3.30</b>	<b>0.608</b>
Formal structure of the work	4	1	80.57	77.88	2.69	0.471
		2	49.80	45.58	4.22	0.359
	<b>Total</b>		<b>65.18</b>	<b>61.73</b>	<b>3.45</b>	<b>0.016</b>

Source: own study

pc2 – probability resulting from the chi-square test

p≤0.05 – significant difference

p≤0.01 – highly significant difference

The analysis indicated that the groups differed in terms of solving tasks in Part I of the test in two cases. A highly significant difference in favour of the boys occurred in the first item of the task diagnosing the perception of harmony structures in the area of tonality. This task involved identifying major and minor-scale melodies. In the next task in this area, there were no statistical differences between the groups. It examined the final tones and involved selecting melody fragments that matched the ending. These tasks gave the poorest results among both the girls and boys, and wrong answers prevailed in both groups.

Another statistical difference, this time in favour of the girls, was noted in the task requiring a description of the formal structure of a piece (ABA).

The task examining the perception of metre (duple or triple metre) gave relatively poor results in both groups and the percentage of correct answers was around 50%.

The group of girls gave the most correct answers to task 3, checking the ability to recognize repetitions of melody which, along with recognizing repetitions of rhythm or harmony, belongs to crucial abilities enabling an analysis of a musical piece structure. In the perception of a piece form, it is important to recognize sections in music, which is closely associated with the understanding of relations between identity, similarity and contrast (Jordan-Szymańska 1990, pp. 141-154; Weiner 2007, p. 23).

A significant percentage of correct answers among the girls was obtained also in task 1, diagnosing the ability to classify the entire melodic realization into a group

of high-, medium- and low-pitched sounds. In the group of boys, however, this very task was ranked the first in terms of correct answers. Another task in this area (2) which involved detection of a melodic contour (rising, falling or breaking) gave poor results in both groups, with the girls giving more wrong than correct answers. The task examining the perception of tempo in the group of boys took the second place in terms of correct answers.

### III. Identity in music, style sensitivity – own study

The first five tasks in Part II of the test verified the perception of melodic stability, while the other two checked style sensitivity. The table below presents detailed data.

**Table 3.** The level of perceptual musical abilities – subtest II

Range	Task number	Items	Girls	Boys	DF	pc2
			%	%	%	
Identity in music: melodic stability	1	1	60.32	53.10	7.22	0.113
		2	46.15	40.27	5.88	0.197
		<b>Total</b>	<b>53.24</b>	<b>46.68</b>	<b>6.56</b>	<b>0.097</b>
	2	1	73.28	65.04	8.24	0.052
		2	44.13	54.87	-10.74	<b>0.020</b>
		<b>Total</b>	<b>58.70</b>	<b>59.96</b>	<b>-1.26</b>	<b>0.238</b>
	3	1	56.68	49.56	7.12	0.121
		2	65.59	62.39	3.20	0.469
		<b>Total</b>	<b>61.13</b>	<b>55.97</b>	<b>5.16</b>	<b>0.215</b>
	4	1	45.75	43.81	1.94	0.671
		2	62.35	58.85	3.50	0.437
		<b>Total</b>	<b>54.05</b>	<b>51.33</b>	<b>2.72</b>	<b>0.201</b>
	5	1	54.25	55.31	-1.06	0.817
		2	46.56	42.04	4.52	0.323
		<b>Total</b>	<b>50.40</b>	<b>48.67</b>	<b>1.73</b>	<b>0.323</b>
Style sensitivity	6	1	57.49	54.87	2.62	0.566
		2	38.06	39.38	-1.32	0.768
		<b>Total</b>	<b>47.77</b>	<b>47.12</b>	<b>0.65</b>	<b>0.953</b>
	7	1	36.03	42.92	-6.89	0.126
		2	37.65	37.17	0.48	0.914
		<b>Total</b>	<b>36.84</b>	<b>40.04</b>	<b>-3.20</b>	<b>0.153</b>

Source: own study

The groups differed statistically only in task 2, and more specifically in the second item of the task, which involved pointing out differences between a pattern and a melody, while the presented excerpts were diversified in terms of tempo and dynamics or only dynamics. Additionally, this task verified what elements of music, tempo or dynamics, affected the perception difficulty (Weiner 2007, p. 33; 61). The research indicated that the boys gave 10.74% more correct answers than the girls. In terms of correct answers, this task was ranked the first in the group of boys, and the second in the group of girls.

A further analysis indicated that the girls were better at solving task 3, in which the children compared two fragments of a musical piece to find a previous pattern, which involved intensive memorizing (Weiner 2007, p. 33). The boys gave fewer correct answers and this task was ranked the second in their group in terms of the number of correct answers. Similarly, the girls obtained a slightly better result in task 4, in which each of the two presented pieces of music was performed by a different group.

Among the tasks verifying the perception of melodic stability, there was also a task (1) which involved 'looking for' a presented melodic pattern in subsequent fragments which were its paraphrases (Weiner 2007, p. 33). In this task, the boys gave more wrong than correct answers. An identical tendency was observed in task 5, which again involved referring to a pattern and some new issues: national dances, folk music and comparison of background and stylized music (Weiner 2007, p. 34). In the group of girls, there were more correct than wrong answers in both tasks.

In both groups, the least-developed competences were related to the perception of style. In tasks 6 and 7, the children were asked to compare pairs of musical fragments and decide whether those were two fragments of the same piece of music, two different pieces by the same composer or two pieces by different composers (Weiner 2007, p. 34). In task 6, the approximate percentage of correct answers was similar but, surprisingly, it turned out to be lower than that of wrong answers. Taking into consideration all the tasks in this part of the test, the most wrong answers were given in task 7 in both groups.

H. Gardner's early research (1973) indicated a significant correlation between the results of tasks verifying style sensitivity and the age of children, while a result better than that of random guessing was in the group of eight-year-old children (as cited in: Sloboda 2002, pp. 260-261). The presented research proves that three- or four-year-old children can already differentiate contrasting musical fragments, and moreover, they are more efficient at evaluating popular than classical music (Marshall, Shibasaki 2011, p. 237; cf. also Marshall, Hargraves 2007). The reference literature stresses that children finishing early-school education are able to perceive and remember unchangeable features of patterns which differ in other respects. It



is also reflexive awareness of structures and patterns characteristic of music and style sensitivity that increase (Sloboda 2002, pp. 256; 260).

#### IV. Associating music with non-musical contents, sound sensitivity – own study

In children's musical education, attention is paid to the analytical and program-interpretative manner of music perception. In analytical listening, it is important to focus on particular elements of music, form or sound. The second manner of perception deals with musical content translated with the use of non-musical plot. However, it should not dominate, but only help to realise particular didactic aims, making the listening to music attractive and preparing the child for comprehending it and using its language in practice (Weiner 2007, pp. 36-37). This type of perception is verified by the first three tasks.

Detailed research results of Part III of the test are presented in the table below.

**Table 4.** The level of perceptual musical abilities – subtest III

Range	Task number	Items	Girls	Boys	DF	pc2
			%	%	%	
Associating music with non-musical contents	1	1	63.56	64.16	-0.60	0.893
		2	53.04	52.65	0.39	0.934
		<b>Total</b>	<b>58.30</b>	<b>58.41</b>	<b>-0.11</b>	<b>0.883</b>
	2	1	62.35	61.95	0.40	0.928
		2	57.89	60.18	-2.29	0.614
		<b>Total</b>	<b>60.12</b>	<b>61.06</b>	<b>-0.94</b>	<b>0.343</b>
	3	1	67.61	64.60	3.01	0.490
		2	53.44	51.33	2.11	0.646
		<b>Total</b>	<b>60.53</b>	<b>57.96</b>	<b>2.57</b>	<b>0.513</b>
Timbre of instruments and human voices	4	1	71.26	74.34	-3.08	0.452
		2	83.00	80.97	2.03	0.447
		<b>Total</b>	<b>77.13</b>	<b>77.65</b>	<b>-0.52</b>	<b>0.736</b>
	5	1	51.01	44.25	6.76	0.141
		2	61.94	50.00	11.94	0.066
		<b>Total</b>	<b>56.48</b>	<b>47.12</b>	<b>9.36</b>	<b>0.002</b>
	6	1	60.32	69.03	-8.71	<b>0.048</b>
		2	59.11	58.85	0.26	0.567
		<b>Total</b>	<b>59.72</b>	<b>63.94</b>	<b>-4.22</b>	<b>0.426</b>

Source: own study

Both groups were statistically different in task 5 and the first item of task 6. In task 5, examining sensitivity to instrumental timbre (trumpet and cello), the girls proved to be much better (the difference of 9.36%). In both groups, however, this task posed many problems to the children, yet the girls gave more correct answers (56.48%), while the boys provided more wrong answers (52.88%). The last task of the test diagnosed the ability to detect human voices. In this task, the children were supposed to indicate a correct type of voice: soprano, alto, tenor, bass, and match the voice with the right name. The first example of this task was performed better by the boys with 8.71% more correct answers than the girls.

The most correct answers were given by both groups in task 4 (more than 77%), in which the pupils were supposed to detect the sound of a performing group – a violin quartet and percussion.

In the tasks which involved associating music with non-musical contents, the correct answers outnumbered the wrong ones in both groups. Task 1 involved associating a fragment of music with movement (walk, run and leaps). Task 2 also referred to some kinaesthetic schemes by connecting a fragment of music with a drawing (graphics: spirals, waves and dots). In task 3, the pupils demonstrated the ability to associate music with a picture, and they could match a piece of music with one out of three pictures (two static and one dynamic) (Weiner 2007, pp. 37-38).

## **Conclusions**

The overall TPMA result indicates the average level of perceptual musical abilities of children. They were most competent in associating music with non-musical contents and the perception of human voices and musical instruments (Part III). The poorest abilities were related to the perception of identity in music and musical style (Part II), and this phenomenon was confirmed in all the research using TPMA. There were few-percentage differences between the research presented herein and the research of A. Weiner and E. Frołowicz, proving that the region where the studies were conducted was a factor modifying the overall test result.

In the research presented herein, gender did not make a statistical difference in particular parts and the whole test. Thus, the results obtained by A. Weiner in the test standardisation have not been confirmed. The research has not confirmed the numerous scientific reports indicating the significant advantage of girls in tests of musical skills, either.

All parts of the test included single tasks or items, the results of which made a statistical difference in both groups, in favour of girls or boys. The analysis

showed that the pupils in both groups gave the most correct answers in one of the tasks diagnosing the ability to recognize the sound of a performing group (a violin quartet and percussion). However, the fewest correct answers were given to items verifying style sensitivity and the perception of harmony structures, which confirms that these skills develop more slowly.

The presented research results provide vital information on the structure and level of perceptual musical abilities of students finishing their elementary education, which, in the absence of standardized assessment tools, makes it possible to take appropriate interactions aimed at eliminating the deficit areas of competence, helping to optimize the teaching and learning of music. This seems particularly important as music education belongs to the abandoned and neglected areas not only in Poland (cf., Russell-Bowie 2009). The research introduces a hitherto non-existent possibility of multidimensional evaluation of students' musical competences in music education.

The effectiveness of early-school music education in Poland can be improved primarily by entrusting its implementation to music teachers who, as experts now having the multidimensional tool for measuring musical abilities, could effectively work on their development. Efforts should also be made to build the awareness of parents regarding their important role in stimulating their children's musical development.

When planning further research, it is worth showing the influence of various types of educational interactions on the development of perceptual musical competences of schoolchildren and comparing the effectiveness of early music education in various countries to exchange experiences and develop the most effective methods in this area.

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