ISSN 2082-6044
ISBN 978-83-64615-33-7

ASPEKTY MUZYKI 2018, TOM 8, s. 263–284

MILENA WIŚNIEWSKA

Wydział Dyrygentury, Kompozycji i Teorii Muzyki
Akademia Muzyczna im. Stanisława Moniuszki w Gdańsku

ul. Łąkowa 1–2, 80–743 Gdańsk
wmilenka@o2.pl

Absolute pitch in persons with visual impairments[1]

Introduction

This paper deals with the topic of musical ear among the visually impaired persons (VIPs), and in particular the ability of absolute pitch (AP) in this group. The inspiration for the present study comes from the subject literature, but also from the author's personal experience. The author noticed that the prevalence of absolute pitch among the blind is unusually high. According to Roy Hamilton (2004), whose study had particular impact on the present paper, over 50% of the blind have AP[2].

However, the literature review of the topic of AP among the blind does not exhaust this subject. While the researchers from Poland have focused on the unique musicality of the blind, sources in other languages pay special attention to the neurological basis of the above-average auditory predispositions in the discussed group. Yet there have been no attempts at determining what factors may affect absolute pitch in the blind. In order to estimate the prevalence of this

[1] M. Wiśniewska, *Badania słuchu muzycznego u osób niewidomych — studia przypadków*, Unpublished BA Thesis, Thesis supervised by: A. Kozłowska-Lewna, Ph. D., Wydział Dyrygentury, Kompozycji i Teorii Muzyki, Akademia Muzyczna im. S. Moniuszki w Gdańsku, 2017.

[2] R. Hamilton, A. Pascual-Leone, G. Schlaug, *Absolute pitch in blind musicians*, „NeuroReport" 2004, Vol. 15, No. 5, p. 804.

ability, among the VIPs and to determine what may influence this phenomenon, the author conducted a twin-track study. The study consisted of the AP test, using the tool designed by Diana Deutsch[3] and Kevin Dooley (2013)[4]. The test was supplemented by a questionnaire designed by the author of this paper.

Absolute pitch in the blind: a literature review

There are three main strands in the studies on the hearing abilities of the blind. The first two concern the hearing ability of the blind and the ability to locate objects on the basis of acoustic stimuli (1985)[5]. In both of these aspects, the opinions of researchers differ considerably. Some of the studies confirm the hypothesis of improved hearing abilities in the blind. Whereas in other experiments, the sighted achieved better results. Yet other studies suggested no difference between the two groups, reporting only differences between the individual subjects. Nowadays, it is assumed that VIPs are merely more attentive to hearing when they receive acoustic stimuli or during spatial navigation. Despite this an opinion that the sense of hearing of a visually impaired person is sharpened in order to compensate for a sight loss still seems widespread.

The third issue frequently discussed is the development of musical ear in the blind. Some authors assume that musical talents are universally possessed by all the VIPs. This view might be the result of the prominent role played by blind musicians over time: from medieval bards, through blind organists, to famous jazz and popular musicians, such as Jose Feliciano, Stevie Wonder, and Ray Charles (2010)[6]. As noted by Paweł Cylulko (1999), music is the most accessible of all arts for the blind who, due to the overall involvement of the auditory analyzer, gain an advantage in the reception of hearing stimuli over the sighted[7].

---

[3] Diana Deutsch is a renowned specialist in the domain of the absolute pitch, author of numerous publications, among others the chapter reviewing the newest research on the absolute pitch: D. Deutsch, *Absolute pitch*, in: *Psychology of music 3rd Edition*, red. D. Deutsch, San Diego: Elsevier 2013, p. 141–182.

[4] D. Deutsch, K. Dooley, *Absolute pitch is associated with a large auditory digit span: A clue to its genesis*, „Journal of the Acoustical Society of America" 2013, Vol. 133, No. 4, p. 1859–1861.

[5] T. Majewski, *Psychologia niewidomych i niedowidzących*, Warszawa 1985, p. 54.

[6] O. Sacks, *Muzykofilia. Opowieść o muzyce i mózgu* [*Musicophilia: Tales of Music and the Brain*], trans. by J. Łoziński, Poznań 2010 [2007], p. 189–194.

[7] P. Cylulko, *Muzykoterapia niewidomych i słabowidzących dzieci*, „Zeszyty Tyflologiczne" 1999, No. 16, p. 25–27.

Researchers have no unequivocal view on this phenomenon. Ewelina Jutrzyna (2007) compared some components of musical hearing in blind, partially-sighted, and sighted children. The results showed no significant difference in the early school age between the studied groups[8]. She pointed out, however, to the variation in the development of the individual components of the musical hearing. Whereas the blind children scored better on harmonic and timbre components, they did worse than their sighted peers on the pitch, rhythmic and tonal components. The author claims that this is due to the specific functioning challenges experienced by blind children.

The idea that musical ear in the blind children is somewhat more developed is corroborated by Waldemar Bogacki's (1980) study, which compares the visually impaired and sighted children in terms of their musical sensitivity, interest in music, and the frequency and forms of contact with this art[9]. The visually-impaired participants presented higher musical intelligence and the willingness to undertake various musical activities. According to the author, this is the result of compensatory mechanisms: blind people choose those activities that are more accessible to them.

A further demonstration of a particularly high level of interest in music and aptitudes in this respect among the blind is provided by the studies conducted by Adam Ockelford (2006, 2009) who studied children with septo-optic dysplasia and[10] retinopathy of prematurity respectively[11]. Blind children examined exhibited a higher level of interest, both in the sounds coming from their environment, and in music and related activities, such as musical improvisation or singing. The authors considered the question of the subjects possessing the absolute pitch — among the group of children with retinopathy there were up to 58% of participants with AP[12].

Some experiments were conducted with the aim of assessing the pitch component of hearing of the blind by, for example, comparing the pitch of the sounds without naming them. Frédéric Gougoux et al. (2004) assessed the ability of the

---

8 E. Jutrzyna, *Terapia muzyką w teorii i praktyce tyflologicznej*, Warszawa 2007, p.121–124.

9 W. Bogacki, *Badania zdolności muzycznych i zainteresowań dzieci niedowidzących w porównaniu z dziećmi normalnie widzącymi*, „Przegląd Tyflologiczny" 1980, No. 2, p. 47–59.

10 A. Ockelford, L. Pring, G. Welch, D. Treffert, *Focus on Music: Exploring the Musical Interests and Abilities of Blind and Partially-sighted Children and Young People witch Septo-optic Dysplasia*, London 2006.

11 A. Ockelford, C. Matawa, *Focus on Music 2: Exploring the Musicality of Children and Young People with Retinopathy of Prematurity*, London 2009.

12 A. Ockelford, C. Matawa, op. cit., p. 30.

blind in this regard in order to determine whether the time of vision loss is relevant for the development of auditory ability[13]. It is possible to infer from the results that people blind since birth showed performance superior to the rest of the control group. The results inside the control group were comparable between each other. The authors argue that these results show effects of compensatory mechanisms, i.e. the ability to reorganize brain in the early childhood. They believe that those neural connections that are related to visual processes can be used by the blind to differentiate sound information.

Van et al. (2010) observed the performance of blind people during auditory perception tasks, as well as whether the period of eyesight loss affected their auditory predispositions[14]. The blind turned out to be the best at tasks concerning the comparison of pitches and categorization of their color. Only in the memory task, the best results were scored by the congenitally blind and the sighted control group, which could be attributed to a sizeable number of people educated musically in both of these groups. The results of this study suggest that the total deprivation of visual stimuli in congenitally blind is more conducive to the development of hearing aptitudes, although the results of the memory test suggest that this does not apply to all auditory tasks. Thus, the base for the better hearing perception of the blind seems to be the plasticity of the brain, which is most pronounced in those who are congenitally blind.

Relatively little research has been devoted to AP in people with impaired vision. The first person to mention this topic was Géza Révész (1953) who, on the basis of personal observations, found that 14% of blind learners had absolute pitch ability, as compared with only 5% of the general population of learners[15]. Graham Welch (1988) took up this remark[16] when during his two-year study of the musicality of students at schools for the blind he accidentally noticed that many students could have an absolute pitch. It turned out that 22 out of 34 participants could be considered to have absolute pitch. Welch concluded that the cause for the greater development of hearing aptitude among the blind is their greater sensory sensitivity.

---

[13] F. Gougoux, F. Lepore, M. Lassonde, P. Voss, R.J. Zatorre, P. Belin, *Neuropsychology: Pitch discrimination in an early blind*, „Nature" 2004, No. 430, p. 309.

[14] C. Van, A. Wood, D. Reutens, S. Wilson, *Early but not late-blindness leads to enhanced auditory perception*, „Neuropsychologia" 2010, Vol. 48, No. 1, p. 344–348.

[15] G. Révész, *Introduction to the Psychology of Music*, London 1953, p. 96, quoted by: G. Welch, *Observations on the incidence of absolute pitch (AP) ability in the early blind*, „Psychology of Music" 1988, Vol. 16, No. 1, p. 78.

[16] G. Welch, op. cit., p. 76–80.

Most of the experiments related to absolute pitch conducted recently have been grounded in neurological studies. The basis for further exploration in this area has been laid by the research team led by Amira Amedi (2005)[17], who confirmed the hypothesis of brain plasticity as a reaction to vision loss. Parts of the brain that control sight receive new functions, contributing to the creation of new cognitive abilities. The brain detects the clearest signal and focuses on it most.

Subsequent experiments follow the same pattern. David Ross (2013) studied the effect of interstitial plasticity of the brain of a blind person on the rise of absolute pitch[18]. It was demonstrated that during the pitch recognition task the same areas of the brain are activated in both the blind and the people with absolute pitch. In the case of the blind, areas normally responsible for visual stimuli were activated additionally.

Roy Hamilton (2004), tried to determine how many blind people might be endowed with absolute pitch and what changes can be observed in the brain of a blind person who has this ability[19]. Of the 21 people that qualified for the experiment as many as 12 (57.1%) declared possessing absolute pitch, however, only in case of seven participants the researchers were able to confirm this using the absolute pitch test. In an identical test conducted on a group of sighted people, 21.6% of participants were confirmed to possess absolute hearing[20]. Blind people endowed with this ability started musical education on average at the age of eight (some even in adolescence), specifically three years later than the sighted. On this basis, the authors presume that when it comes to the blind, we cannot talk about the so-called critical period for the rise of absolute pitch. A comparison of the results of magnetic resonance imaging showed that left-sided asymmetry is not always present in the sighted people who have this ability. It is therefore not a condition that determines this type of ability in the blind. In addition, the research points out to the increased, as compared with sighted musicians with absolute pitch, asymmetry of the area of the brain known as *planum temporale*, a part of the cortex that is responsible for the perception of speech and sounds,

---

17 A. Amedi, L. Merabet, F. Bermpohl, A. Pascual-Leone, *The occipital cortex in the blind: Lessons about plasticity*, „Current Directions in Psychological Science" 2005, Vol. 14, No. 6, p. 306–311.

18 D. Ross, I. Olson, J. Gore, *Cortical plasticity in an early blind musician*, „Magnetic Resonance Imaging" 2003, Vol. 21, No. 7, p. 821–827.

19 R. Hamilton, A. Pascual-Leone, G. Schlaug, op. cit., p. 803–806.

20 J. Keenan, V. Thangaraj, A. Halpern, G. Schlaug, *Absolute pitch and planum temporale*, „NeuroImage" 2001, Vol. 14, No. 1, p. 1302–1308.

associated with auditory processing[21]. This asymmetry was not observed in blind musicians who did not possess absolute pitch. The mechanisms that contribute to the development of AP in the blind could therefore be different from those that determine its presence in the sighted.

A group of researchers led by Nadine Gaap (2006) attempted to determine whether the specific brain activation described above was also observed in blind individuals in other situations not related to absolute pitch[22]. The auditory tasks demonstrated that the blind display less activity in the brain areas that are responsible for the absolute pitch in the sighted. Contrary to what was previously thought, the brain of the blind showed the use of visual association mechanisms, not the areas responsible for visual functions. Based on previous research, it was suggested that these areas in the brain of the blind which receive a new function, use it not only for musical tasks, but generally in other hearing-related processes. The cerebellum, in turn, was shown to be less active, its activity being probably redirected to the above mentioned areas. Through the involvement of the latter areas, the blind gain a better chance for developing the absolute pitch as well as prolonging the critical period for this process.

The study

Research design and methodology

The above research findings confirm that the blind are often especially predisposed in the sphere of music, possess a developed musical ear, moreover, many of them have the absolute pitch. Also, interesting is the indication of the possibility of the non-occurrence in the blind of the critical period for the development of the absolute pitch. The main aim of this article is the verification of the data concerning the number of the blind people with AP and finding the factors shaping the musical ear in the researched group.

Based on the reviewed literature and the author's observations, the following hypotheses were formulated:

H1. There is a larger percentage of the blind, as compared with the sighted, who possess AP.

---

[21] „Planum temporale", https://www.sciencedirect.com/topics/neuroscience/planum-temporale (access: 24.04.2017).

[22] N. Gaap, K. Schulze, E. Ozdemir, G. Schlaug, *Neural correlates of absolute pitch, differ between blind and sighted musicians*, „NeuroReport" 2006, Vol. 17, No. 18, p. 1853–1857.

In the research of Roy Hamilton as many as 57.1% of the examined blind subjects declared the possession of the absolute pitch[23]. The theory that the absolute hearing is encountered more frequently in people with sight dysfunction is very popular, often the abilities of the blind as far as the absolute hearing is concerned are overestimated, assuming that all people with sight dysfunction are predisposed to hear better.

H2. The critical period for the development of AP does not apply to the blind.

It can be noticed that many blind people possess the absolute pitch skills, irrespective of the age at which they commenced music education. The proof of this is the research of Roy Hamilton. The blind musicians with absolute pitch researched by him started music education on average three years later than the sighted with AP examined with the use of the same test[24].

H3. The AP in the blind is not dependent on continuous musical practice.

So far this has not been addressed in any research. Based on the observation of the blind it can be inferred that they maintain the absolute hearing even if they do not interact with music anymore and have no contact with a musical instrument.

H4. The AP in the blind does not directly depend on the duration of musical education.

This problem has not been addressed so far, because the researchers of the absolute pitch in the blind provide data concerning the commencement of the education by the blind, rather than its length. There are indicators which suggest that the blind with AP possess this ability independent of the length of time they have spent learning music. The possession of absolute pitch is observed in people with sight dysfunction who learned music for a very short time, yet, there are also cases of the blind who do not have the absolute pitch and whose music education lasted for several years.

H5. Family environment and early childhood exposure to music may be factors that directly contribute to the development of AP in the blind.

The influence of the family environment on the music ability and music development of children is undeniable. According to Maria Manturzewska, both music tradition at home and the parents' attitude to the music path chosen by their children are of paramount importance[25]. As Gabriela Konkol claims, all the activities of the family concerning the musical development of the child, includ-

---

23 R. Hamilton, A. Pascual-Leone, G. Schlaug, op. cit., p. 804.

24 Ibidem, p. 805.

25 M. Manturzewska, *Psychologiczne warunki osiągnięć pianistycznych*, Wrocław 1969, p. 124.

ing showing interest and motivating to further work, are helpful; yet, they do not constitute the prerequisite to the child's achievement of success in the domain of music[26].

It is common knowledge that musical abilities should not be treated as features which are typically inherited; they can be, in favorable conditions, strengthened by the stimulation at home. Based on this, it could be inferred that the amount of time the child spends surrounded by music at home could be one of the most important factors influencing the development of the child's musical ear as well as the absolute pitch.

Similarly to sighted children, perhaps even more so, the parents influence the development of different passions, including music, through arousing the child's interest in various activities. In consequence, the child's music abilities, including good ear for music will be developed since early childhood. It is to be remembered that blind children, if not stimulated properly from the very beginning, are prone to develop social abnormalities[27]. Therefore, the role of the parent is especially significant. Parents should develop the child's interest in many spheres; however, it appears that introducing the child to the world of music is the most natural thing for a parent to do, and, at the same time, it is the most interesting activity for the child (other activities connected with the visual domain might be difficult to introduce to the child).

Both qualitative and quantitative methods were employed in the research (among the latter, data analysis and mean results analysis). However, the leading method was case studies analysis, as those have allowed for the reliable presentation of the stories and aptitudes of all the participants.

A twin-tracked procedure has been adopted. The first component of the study was the AP test elaborated by Diana Deutsch and Kevin Dooley[28], composed of 36 electronic piano sounds, from small to two-line octave, arranged in three series. The test consists of all the pitches of the chromatic scale assigned randomly, and the intervals between the successive sounds are always larger than the octave. Participants were supposed to name the sounds, without specifying the octave. In order to be considered as possessing absolute pitch, it was neces-

---

[26] G. Konkol, *Rodzina i środowisko rodzinne jako wyznacznik powodzenia w działalności muzycznej*, in: *Psychologiczne podstawy kształcenia muzycznego, materiały z ogólnopolskiego seminarium dla nauczycieli i psychologów szkół muzycznych*, red. M. Manturzewska i M. Chmurzyńska, Warszawa 2001, p. 137–146.

[27] W. Szuman, *Wychowanie niewidomego dziecka*, Warszawa 1961, p. 58.

[28] D. Deutsch, *Play sound file: Test for Absolute Pitch* [online], http://deutsch.ucsd.edu/psychology/pages.php?i=6215 (access: 25.04.2017).

sary to identify at least 80% of the sounds, mistakes in halftones were not taken into account.

Due to the fact that the participants were from different parts of Poland and three of them lived abroad, it was not possible to reach all of them personally in order to carry out the first part of the study. The test was administered to some of them in person, but most have been tested online, and in the case of a few people, due to technical problems, the author was forced to play a sound file via telephone connection (these difficulties did not affect the results of the tests, because all people tested in the latter way have achieved very good results).

The second part of the study was carried out using a questionnaire, consisting of twenty-one questions, both closed and open. Questions included information on disability, musical education and practice, the presence of music in the family environment, as well as the participant's musical abilities. These data were used to create case studies of all the subjects and to draw more general conclusions about the nature of absolute pitch in the sample. The questionnaire was completed by all the participants via the Internet.

A group of participants consisted of 30 blind people, 9 female, 21 male, aged between 12–38, possessing a varied level of musical experience. 26 of them were congenitally blind. Most of the participants were totally blind (20), and only some had light perception (8) or residual sight, allowing them, for example, to see the contours of object (2). As many as fourteen people were brought up in the family where at least one member was to some extent involved in music.

During all the stages of the study, the researcher took special care so that the methods and tools used were fully accessible to the visually impaired, who work with the computer using special technologies such as screen reading software.

Results (see table 1)

Twenty-two participants declared that they had absolute pitch, and eight had reported relative pitch. Of the AP group, twenty described their hearing ear as active and two as passive[29]. Nineteen had AP for as long as they remember, and three persons reported acquiring this ability during musical education.

The mean score for the entire group on the AP test was 63.7% of the correct answers (mean 22.93 points out of 36 possible).

[29] People with active AP can both recognise and sing a given pitch without having any point of reference. Those who have passive AP can only name a given tone, but they find it difficult to sing it.

Table 1. Individual scores of participants in the Deutsch's perfect pitch test

No.	Name	Score in per cent	Number of correct answers	Number of semitone errors	Number of errors of more than one semitone	Number of unnamed sounds
1	Oliwia	100%	36	0	0	0
2	Antoni	100%	36	0	0	0
3	Tomasz K.	100%	36	0	0	0
4	Tomasz B.	100%	36	0	0	0
5	Roberto	100%	36	0	0	0
6	Patryk	100%	36	0	0	0
7	Paulina	100%	36	0	0	0
8	Kaja	100%	36	0	0	0
9	Maksymilian	100%	36	0	0	0
10	Grzegorz D.	100%	36	0	0	0
11	Oskar	97.2%	35	1	0	0
12	Michał	88.9%	32	2	1	1
13	Rafał	88.9%	32	4	0	0
14	Wojciech	86.1%	31	5	0	0
15	Agata Z.	75%	27	7	2	0
16	Dorota	72.2%	26	10	0	0
17	Karol	66.7%	24	10	2	0
18	Hubert	66.7%	24	10	0	2
19	Natalia	63.9%	23	7	6	0
20	Marcin	58.3%	21	12	3	0
21	Piotr	55.6%	20	13	3	0
22	Grzegorz P.	36.1%	13	17	5	1
23	Milena	19.4%	7	2	2	25
24	Martin	19.4%	7	8	17	4
25	Przemysław	11.1%	4	4	25	3
26	Szymon	2.8%	1	5	15	15
27	Agata B.	2.8%	1	7	22	6
28	Daria	0%	0	1	7	28
29	Edwin	0%	0	2	11	23
30	Kamil	0%	0	0	0	36

However, the results obtained by individual participants varied. On the basis of the results, the respondents could be divided into three groups.

The first group, the AP group, consisted of people who scored more than 80% of the correct answers, so that, according to the criteria adopted by Diana Deutsch (2013), they could be regarded as possessing absolute pitch. They got 97.2% of correct answers (35 points). This group included fourteen participants, with ten of them completing the test without any mistake. The average age of the commencement of musical education among the members of this group was 7.61 years. One thing to keep in mind though is that one of the participants started learning music much later than all the others, at the age of 21, which skewed the average. If we do not take into account this participant, then we get 6.58 years as the average age when the musical education started. This group mostly comprised of people who were learning music for a dozen or so years, some of the participants had a relatively short schooling time, and the two youngest participants still attended the music school. Nearly all those belonging to this group indicated that they had contact with music at home since early childhood, and, in some cases, this contact was quite intense. That was the case for one of the participants, whose story seems particularly interesting.

Tomasz is currently 20 years old, he is totally blind from birth.

His father, who played bass guitar, provided him with exposure to music from early childhood. Because of his father, music was all around his home, there was bass guitar, but also a keyboard, which he received at the age of five.

When Tomasz was eight years old, his parents enrolled him for musical lessons at a cultural institution where he learned to play the piano, with classes focused on jazz and entertainment. Those were private classes, held in a public institution. Apart from these classes, the student did not attend a music school or any other institution of formal musical education. At present, he rarely uses his musical talents, he devotes himself to his second passion, computer science.

Tomasz described himself as possessing absolute pitch and active form of musical ear for as long as he could remember. It is hard for him to pinpoint the moment when he realized this ability, he learnt the names of the sounds when he got his first keyboard instrument, and then tried to name the sounds played by his father. It is probably due to the family circumstances that the participant, despite not having any formal musical training, has such a well-developed musical ear. He can determine the pitch irrespective of the sound timbre.

The experiment with Tomasz was carried out remotely over *Teamtalk* software. He got all the answers correct.

The second group, the intermediate group, included those who scored less than 80% (from 75% to 36.1%) on the absolute pitch test, whose wrong answers mainly consisted of half-tones. Some of the researchers, as is generally acknowledged, consider these to be minor mistakes and treat answers that contain them as correct. For example, Annie Takeuchi (1991), accepted half-tone mistakes in her AP test, moving the threshold to 90% of correct answers in order for the participant to be considered as possessing absolute pitch[30]. On the other hand, Peter Gregersen et al. (2013) awarded only half a point for the answers containing half-tone mistakes[31]. A similar factor was adopted by Baharoo et al. (1998); yet, in the case of the research subjects more than 45 years old they awarded one point for half-tone mistakes[32]. If the criteria adopted by Diana Deutsch (2013) in the test used in this study were relaxed, or if a different AP test was employed, all these participants could be included in the first group. In addition, all of them reported possessing absolute pitch. On average, people in this group scored 57.3% correct answers (22.25 points). There were eight participants in this group. The average age of starting musical education was 7.63 years. Only one of the participants from this group had a brief experience of musical education, all others attended music classes for several or more years. Similar to the previous group, most of the participants from the intermediate group had been exposed to music since childhood. However, the number of respondents who experience intense exposure to music was smaller, as compared with the first group. Obviously, it is hard to make such comparisons between the groups because of differences in their size. Thus, one cannot unequivocally claim that such comparisons hold, since they cannot be accurately accounted for.

Of particular relevance for the author was the case of Natalia, who scored results that were close to the average scored by the participants from this group. Natalia is 26 years old. She is totally blind from birth.

Despite the fact that none of Natalia's family members has a higher musical education, they were exposed to music, which played an important part in the life of all the members of her household. When Natalia was a child, they would

---

[30] A. Takeuchi, S. Hulse, *Absolute-pitch judgments of black and white-key pitches*, „Music Perception" 1991, Vol. 1, No. 1, p. 27–46.

[31] P. Gregersen, E. Kowalsky, A. Lee, S. Baron-Cohen, S. Fisher, J. Asher, D. Ballard, J. Freudenberg, W. Li, *Absolute pitch exhibits phenotypic and genetic overlap with synesthesia*, „Human Molecular Genetics" 2013, Vol. 22, No. 10, p. 2097–2104.

[32] S. Baharloo, P. Johnston, S. Service, J. Gitschier, N. Freimer, *Absolute pitch: An approach for identification of genetic and non-genetic components*, „American Journal of Human Genetics" 1998, Vol. 62, No. 1, p. 224–231.

often sing together. At home they had a variety of instruments, including a piano and a small violin. From her early childhood, Natalia was also taught to listen carefully to music.

She began her regular music education at the age of six, but had previously tried to play and sing with her grandmother. For a year she attended piano classes at a community centre, then she got a place in the primary music school where she continued to practice playing piano. When she was ten, she decided to swap the instrument and she took up violin classes, again in the primary music school which lasts for four years. She graduated from the secondary music school, where she continued to play violin, and later, also at secondary music school, she began playing flute. Now she is in fourth grade. Simultaneously, she studied music education at the University of Silesia and received a Master's degree in this field. Additionally, she is an amateur guitar and pan flute player. She was educated exclusively in public schools.

Natalia claims to possess absolute pitch in its active form. She reports that she has acquired this ability during her training. She learnt that she had absolute pitch when she was eight. In her opinion, an improved understanding of the timbre of an instrument can be helpful in recognizing the sound coming from it.

Natalia participated in the experiment using the *Teamtalk* software. She correctly identified 23 sounds, representing 63.9% of correct answers. This score was a surprise to her, as in all the previous AP tests she scored better results. Moreover, it can be inferred from her description that those tests were also based on electronically generated sounds. Perhaps the reason for this result was the timbre of the sounds employed in the test. In fact, she pointed out that the sound caused some problems to her. This seems to be in line with Ken'ichi Miyazaki's findings, who, comparing the results of seven people possessing AP, has shown that they are better at recognizing the sounds of the piano than those that are generated electronically, such as, in this case, synthesized multitones[33]. The lowering of the score in the absolute pitch test could have been caused by the frequent change of the instrument. According to research, the subjects recognize the best the sounds of the instrument which they had learned to play earlier[34].

The third group comprised the subjects who did not display the tendency for possessing absolute pitch. The scores of participants from this group also varied,

---

[33] K. Miyazaki, *Absolute pitch identification: Effects of timbre and pitch region*, „Music Perception" 1989, Vol. 7, No. 1, p. 1–14.

[34] D.C. Sergeant, *Pitch perception and absolute pitch: A study of some aspects of musical development, doctoral dissertation*, Reading University 1969.

with two people scoring 19.4% and three other not being able to correctly identify a single sound. The average score in this group was 6.93% (2.5 points), and the group also had eight participants. The respondents from this group began to learn music relatively late. Their musical education begun, on average, at the age of 8.75 years. There are no significant differences between the second and third group in terms of the duration of their music education and the exposure to music at home.

The case of Martin is representative for this group. It also illustrates the adopted hypothesis that there is no correlation between the duration of music education and musical ear of the blind.

Martin is 25 years old and is visually impaired from birth. He has residual sight which supports him in his day-to-day activities.

Music was a very important element in Martin's life. His grandmother was not a qualified musician, but she was an organist in the parish church. Her brothers played wind instruments, one reed woodwinds, and the other brass wind. The mother of the subject sang in the school choir and the church chapel, and her sister graduated from the piano class in the secondary music school. Martin's father played trombone in an orchestra and in a big band. Singing was an indispensable part of any family celebration.

Martin began his musical education at the age of six, enrolled by his parents and maternal grandparents. During the first year, he took private keyboard and accordion lessons with his parents' friend. For the next three years he only had music lessons at a regular primary school, where the music teacher, seeing his musical talent, devoted more time to him than to other pupils. When the subject was ten years old, he started attending primary music school at the school for the blind in Krakow, where he practiced playing accordion. It was a special period in the operation of this school when it was geared toward integrating with the sighted, so most of the pupils in his class did not have any vision impairment. Then he began studying instrument tuning and equalization at the technical secondary school, where they had compulsory piano classes. That was also at the same school for the blind. Martin had always dreamed of learning to play trumpet. When he was sixteen, he started looking for information on how to practice playing it. Two years later, he began attending classes at a community music centre, which was open to the general public. For two years he had been preparing for the exams to the secondary music school, which he successfully passed. He is currently a fifth-grade student of this school. Since there used to be an early music department at that school, Martin also received extra classes in natural trumpet.

In addition, he is a self-taught sax, clarinet, trombone and pan flute player. At all stages of his education he had compulsory piano lessons.

Martin reported possessing relative pitch. He believes that music education, including the ear training, has improved his musical ear. Since his main instrument is the trumpet, he is at his best when recognizing the sounds of this instrument. A less developed hearing ability in this case is perhaps due to the frequent changes of the instruments which the subject learned to play. It may also be the result of his visual impairment. His sight is poor, but sufficient for Martin to be able to use it actively. Thus, sight supports him in his everyday life. It is possible that for this reason hearing plays a somewhat smaller role, and, consequently he did not develop higher auditory skills, despite the favorable conditions prevailing in his family.

Martin participated in the study using the *Teamtalk* software. He correctly identified seven pitches he heard, which is a score of 19.4% of the correct answers.

Interpretation of results and discussion

The analysis of the results presented above allows us to verify the initial hypotheses. The hypothesis concerning the frequent occurrence of absolute pitch among the blind was corroborated. The prevalence of this characteristics in the sample was 46.7%. This result is even more impressive, because the employed test was composed of electronically-generated sounds, which is quite difficult even for many people with AP[35]. It is generally acknowledged that it is hard to estimate the prevalence of AP in the population at large. This is due to the fact that researchers are adopting various criteria and using varied tools to measure them[36]. Oliver Vitouch writes that according to different researchers the frequency of the occurrence of the absolute pitch in general population oscillates between 1:100000 and 1:1000; yet, for professional musicians it ranges between 1:100 and 1:5[37]. The advantage of the blind musicians is visible here; as much as half of them may possess the absolute pitch.

---

35 K. Miyazaki, op. cit.

36 A. Kozłowska-Lewna, *Słuch absolutny w świetle współczesnych badań*, „Konteksty Kształcenia Muzycznego" 2014, No. 1, p. 29.

37 O. Vitouch, „Absolutes Gehör", entry in: *Enzyklopädie der Psychologie: Allgemeine Musikpsychologie*, Hrgs. v. T.H. Stoffer, R. Oeter, Göttingen 2005, p. 719, quoted by: A. Kozłowska-Lewna, op. cit.

The hypothesis, based on the conclusions from Roy Hamilton's (2004) study, that in the case of blind people one cannot speak of a critical period in the formation of AP was not fully confirmed. Subjects from both the absolute pitch and intermediate group started their music education at the age of seven, when, according to researchers, this critical period would have already been passed[38]. Those who started their music education later, i.e. at the age of nine, did not possess the absolute pitch. It is difficult to assess to what extent these results reflect the real situation, and to what extent they are the result of the sample selection. On the other hand, it can be seen that many of the participants with AP had shown its manifestations in the early childhood, prior to receiving any music education. That would suggest that aptitudes for developing AP among the blind have a special character and may exist independently of any music education.

The hypothesis that the predispositions for absolute pitch in the blind are not dependent on continuous musical practice has been confirmed, as these aptitudes can even be observed in people who have not actively studied music for years. In addition, the sample showed no relationship between AP and the duration of music education, since it contained cases of people who learnt music for a brief time and yet showed hearing talents (one of the participants who enjoyed AP in reality had never learnt music, and he only learnt the names of different pitches by the age of 21). However, it is the family environment that may have an impact on the development of hearing abilities among the blind, since many people from the AP group started their adventure with music in the early childhood with intense or very intense exposure to music in most of the cases. As there is no particular difference between the intermediate group and the group without AP, it seems that a family environment rich in musical experience may be conducive for the development of auditory predispositions in the blind, but it is not a prerequisite for this process.

This analysis shows that the blind, probably due to the exceptional auditory sensitivity, have greater predispositions to absolute pitch, independent of external conditions. Due to this factor, the percentage of the blind with absolute pitch is far superior to that percentage among the sighted. Since the impact of most of the above-mentioned factors on the hearing of the blind has not been studied, it is necessary to carry out further studies with a greater sample.

---

[38] D.C. Sergeant, *Experimental investigation of absolute pitch*, „Journal of Research in Music Education" 1969, Vol. 17, No. 1, p. 135–143, quoted by: R. Shuter-Dyson, C. Gabriel, *Psychologia uzdolnienia muzycznego* [Psychology of Musical Ability], trans. by E. Głowacka, K. Miklaszewski, Warszawa 1986, p. 132.

It has to be stressed that in some respects the sample proved to be too homogeneous. Thus, it was impossible to determine precisely the impact of the factors related to visual impairment on the studied phenomenon. As has been mentioned, congenitally blind clearly outnumber adventitiously blind and low sighted. It is possible to put forward a preliminary hypothesis, based also on Catherine Van (2010) study[39], that the congenitally blind are more likely to develop special auditory predispositions, and that better musical ear is more common in totally blind and people with light perception than in those who have residual vision and thus are able to use this sense in a more active way. Due to the disproportions in the sample, these assumptions should be treated with great caution and require further research.

The question remains, therefore, what is the ultimate cause of such a high prevalence of absolute pitch among the blind. The analysis of the available sources suggests that factors with great impact on this aspect are neurological aptitudes and, more specifically, the involvement of the visual areas of the brain which take up hearing functions. Through this process the blind are granted new opportunities for developing their hearing abilities. With additional brain areas responsible for hearing, they are more likely to develop better auditory skills. Special conditions for brain development have also been found in the sighted who developed AP. Psyche Loui (2011) has shown that sighted people who possess AP have extra connections in the brain that may be the result of this ability[40].

As early as in 1944, Albert Bachem pointed out that the frequent occurrence of absolute pitch among the blind contradicts a popular claim that this ability is inheritable[41]. This observation corresponds with the results of subsequent studies conducted by Graham Welch (1988). He posited that research on AP among the visually impaired may provide data on the general nature of this phenomenon[42]. That is why further experiments and observations in this area are necessary. The author expresses her hope that thanks to the present study some issues related to the development of absolute pitch in the blind have been clarified.

---

39 C. Van, A. Wood, D. Reutens, S. Wilson, op. cit., p. 346.

40 P. Loui, C.C. Hui Li, A. Hohmann, G. Schlaug, *Enchanced cortical connectivity in absolute pitch: A model for local hyperconnectivity*, „Journal of Cognitive Neuroscience" 2011, Vol. 23, No. 4, p. 1015–1026.

41 A. Bachem, *The genesis of absolute pitch*, „Journal of the Acoustical Society of America" 1944, Vol. 11, No. 1, p. 434–439, quoted by: P. Bermudez, *The neural correlates of absolute pitch, doctoral dissertation*, Montreal 2008, p. 11 [online], https://www.researchgate.net/publication/38135229_Neural_correlates_of_absolute_pitch (access: 28.05.2017).

42 G. Welch, op. cit., p. 79.

It can be noticed that the blind often possess an enormous music potential and willingness to undertake music activity — music is the most accessible form of art for the visually impaired. Therefore, as Waldemar Bogucki emphasizes, it is paramount to ensure that the blind have equal chances in gaining musical skills[43]. As Wanda Szuman pointed out, the enthusiasm of the blind towards music is noticeable since early childhood[44]. For many blind people music might become an essential part of life. Hence, it is of tremendous importance that this potential is noticed and developed early on.

[43] W. Bogacki, op. cit.

[44] W. Szuman, op. cit., p. 58–62.

ABSTRACT

This paper focuses on absolute pitch (AP) in the blind. The article is based on the research conducted by Roy Hamilton and Nadine Gaap, as well as the author's own experience which suggest a higher prevalence of the AP in the blind than in the population at large. Thus, the main purpose of the paper was the study of this phenomenon, as well as an attempt at isolating factors contributing to the development of AP in the blind.

The following hypotheses were formulated:

H1: There is a larger proportion of AP-endowed blind, as compared with the sighted.

H2: The critical period for the rise of AP does not apply to the blind.

H3: The AP among the blind is not dependent on continuous music practice.

H4: The AP in the blind does not directly depend on the duration of their musical education.

H5: The family circumstances and early exposure to music may be factors contributing to the development of AP in the blind.

Test for Absolute Pitch prepared by Diana Deutsch and the author's survey comprising 21 questions were used as research tools. Thirty blind subjects took part in the study. Out of 30 subjects, as many as 14 (46.7%) were identified as endowed with AP. Out of these, 10 did not make any mistake in identifying all the pitches, despite the fact that the participants had a varying degree of musical education and knowledge about music. Four of the above-mentioned hypotheses were confirmed, with only one, that on the critical period in the rise of AP in the blind (H2), was falsified.

KEYWORDS: research of music abilities in blind people, absolute pitch

STRESZCZENIE

Badania nad zdolnością do słyszenia absolutnego osób niewidomych

Przedmiotem artykułu jest zdolność do absolutnego słyszenia u osób niewidomych. Punktem wyjścia dla podjętych rozważań stały się doniesienia Roya Hamiltona oraz Nadine Gaap, a także własne obserwacje autorki o częstszym — niż w normalnej populacji — występowaniu słuchu absolutnego u niewidomych. Głównym celem pracy stało się zatem zbadanie tego zjawiska, a także próba wskazania czynników mających na nie wpływ.

Sformułowano następujące hipotezy badawcze:

H1: Wśród niewidomych większy, niż wśród widzących jest procent osób posiadających słuch absolutny.

H2: U niewidomych nie obserwuje się okresu krytycznego przy powstawaniu słuchu absolutnego.

H3: Zdolność do słyszenia absolutnego u osób niewidomych nie jest zależna od ciągłej praktyki muzycznej.

H4: Zdolność do absolutnego słyszenia u osób niewidomych nie zależy w sposób bezpośredni od czasu kształcenia muzycznego.

H5: Środowisko rodzinne i obcowanie z muzyką od wczesnego dzieciństwa mogą być czynnikami wpływającymi bezpośrednio na wykształcenie się słuchu absolutnego u niewidomych.

Jako narzędzia badawcze wykorzystano test słuchu absolutnego (ang. Test for Absolute Pitch) Diany Deutsch oraz kwestionariusz autorski składający się z 21 pytań. W badaniu wzięło udział 30 niewidomych.

Na trzydziestu badanych aż czternastu (46,7%) zostało zakwalifikowanych jako posiadacze słuchu absolutnego, przy czym dziesięciu z nich nie popełniło żadnego błędu w identyfikacji słyszanych wysokości, mimo że w badanej grupie znajdowały się osoby o bardzo zróżnicowanym poziomie muzycznego wykształcenia i wiedzy w tym zakresie. Potwierdzono słuszność czterech sformułowanych wyżej hipotez. Nie potwierdziła się jedynie hipoteza o niewystępowaniu okresu krytycznego w kształtowaniu się zdolności do słyszenia absolutnego u osób niewidomych.

SŁOWA KLUCZOWE: badanie poziomu zdolności muzycznych u osób niewidomych, słuch absolutny

LIST OF REFERENCES

Amedi Amir, Merabet Lotfi, Bermpohl Felix, Pascual-Leone Alvaro, *The occipital cortex in the blind: Lessons about plasticity and vision*, „Current Directions in Psychological Science" 2005, Vol. 14, No. 6, p. 306–311.

Baharloo Siamak, Johnston Paul, Service Susan, Gitschier Jane, Freimer Nelson, *Absolute pitch: An approach for identification of genetic and non-genetic components*, „American Journal of Human Genetics" 1998, Vol. 62, No. 1, p. 224–231.

Bermudez Patrick, *The neural correlates of absolute pitch*, doctoral dissertation, Montreal 2008 [online], https://www.researchgate.net/publication/38135229_Neural_correlates_of_absolute_pitch (access: 28.05.2017).

Bogacki Waldemar, *Badania zdolności muzycznych i zainteresowań dzieci niedowidzących w porównaniu z dziećmi normalnie widzącymi*, „Przegląd Tyflologiczny" 1980, No. 2, p. 47–59.

Cylulko Paweł, *Muzykoterapia niewidomych i słabowidzących dzieci*, „Zeszyty Tyflologiczne" 1999, No. 16, p. 25–27.

Deutsch Diana, *Play sound file: Test for Absolute Pitch* [online], http://deutsch.ucsd.edu/psychology /pages.php?i=6215 (access: 25.04.2017).

Deutsch Diana, Dooley Kevin, *Absolute pitch is associated with a large auditory digit span: A clue to its genesis*, „Journal of the Acoustical Society of America" 2013, Vol. 133, No. 4, p. 1859–1861.

Gaap Nadine, Schulze Katrin, Ozdemir Elif, Schlaug Gottfried, *Neural correlates of absolute pitch, differ between blind and sighted musicians*, „NeuroReport" 2006, Vol. 17, No. 18, p. 1853–1857.

Gougoux Frédéric, Lepore Franco, Lassonde Maryse, Voss Patrice, Zatorre Robert J., Belin Pascal, *Neuropsychology: Pitch discrimination in an early blind*, „Nature" 2004, No. 430, p. 309.

Gregersen Peter, Kowalsky Elena, Lee Annette, Baron-Cohen Simon, Fisher Simon, Asher Julian, Ballard David, Freudenberg Jan, Li Wentian, *Absolute pitch exhibits phenotypic and genetic overlap with synesthesia*, „Human Molecular Genetics", Vol. 22, No. 10, p. 2097–2104.

Hamilton Roy, Pascual-Leone Alvaro, Schlaug Gottfried, *Absolute pitch in blind musicians*, „NeuroReport" 2004, Vol. 15, No. 5, p. 803–806.

Jaśkowski Piotr, *Neuronauka poznawcza. Jak mózg tworzy umysł*, Warszawa 2009.

Jutrzyna Ewelina, *Terapia muzyką w teorii i praktyce tyflologicznej*, Warszawa 2007.

Keenan Julian, Thangaraj Ven, Halpern Andrea, Schlaug Gottfried, *Absolute pitch and planum temporale*, „NeuroImage" 2001, Vol. 14, No. 1, p. 1302–1308.

Konkol Gabriela, *Rodzina i środowisko rodzinne jako wyznacznik powodzenia w działalności muzycznej*, in: *Psychologiczne podstawy kształcenia muzycznego, materiały z ogólnopolskiego seminarium dla nauczycieli i psychologów szkół muzycznych*, red. M. Manturzewska i M. Chmurzyńska, Warszawa 2001, p. 137–146.

Kozłowska-Lewna Alicja, *Słuch absolutny w świetle współczesnych badań*, „Konteksty Kształcenia Muzycznego" 2014, No. 1, p. 27–36.

Loui Psyche, Hui Charles, Hohmann Anja, Schlaug Gottfried, *Enhanced cortical connectivity in absolute pitch musicians: A model for local hyperconnectivity*, „Journal of Cognitive Neuroscience" 2011, Vol. 23, No. 4, p. 1015–1026.

Majewski Tadeusz, *Psychologia niewidomych i niedowidzących*, Warszawa 1985.

Manturzewska Maria, *Psychologiczne warunki osiągnięć pianistycznych*, Wrocław 1969.

Miyazaki Ken`ichi, *Absolute pitch identification: Effects of timbre and pitch region*, „Music Perception" 1989, Vol. 7, No. 1, p. 1–14.

Ockelford Adam, Matawa Christina, *Focus on Music 2: Exploring the Musicality of Children and Young People with Retinopathy of Prematurity*, London 2009.

Ockelford Adam, Pring Linda, Welch Graham, Treffert Darold, *Focus on Music Exploring: the Musical Interests and Abilities of Blind and Partially-sighted Children and Young People with Septo-optic Dysplasia*, London 2006.

„Planum temporale", https://www.sciencedirect.com/topics/neuroscience/planum-temporale (access: 24.04.2017).

Ross David, Olson Ingrid, Gore John, *Cortical plasticity in an early blind musician*, „Magnetic Resonance Imaging" 2003, Vol. 21, No. 1, p. 821–828.

Sacks Oliver, *Muzykofilia: opowieść o muzyce u mózgu* [*Musicophilia: Tales of Music and the Brain*], trans. by Jerzy Łoziński, Poznań 2010 [2007].

Sergeant Desmond Clive, *Pitch perception and absolute pitch: A study of some aspects of musical development*, doctoral dissertation, Reading University 1969.

Shuter-Dyson Rosamund, Gabriel Clive, *Psychologia uzdolnienia muzycznego* [*Psychology of Musical Ability*], trans. by Ewa Głowacka, Kacper Miklaszewski, Warszawa 1986 [1982].

Szuman Wanda, *Wychowanie niewidomego dziecka*, Warszawa 1961.

Takeuchi Annie, Hulse Stewart, *Absolute-pitch judgments of black and white-key pitches*, „Music Perception" 1991, Vol. 1, No. 1, p. 27–46.

Van Catherine, Wood Amanda, Reutens David, Wilson Sarah, *Early but not late-blindness leads to enhanced auditory perception*, „Neuropsychologia" 2010, Vol. 48, No. 1, p. 344–348.

O. Vitouch, „Absolutes Gehör", entry in: *Enzyklopädie der Psychologie: Allgemeine Musikpsychologie*, Hrgs. v. T.H. Stoffer, R. Oeter, Göttingen 2005, p. 718–766.

Welch Graham, *Observations on the incidence of absolute pitch (AP) ability in the early blind*, „Psychology of Music" 1988, Vol. 16, No. 1, p. 77–80.

Wiśniewska Milena, *Badania słuchu muzycznego u osób niewidomych — studia przypadków*, Unpublished BA thesis, Thesis Supervisor: Alicja Kozłowska-Lewna, Ph. D., Wydział Dyrygentury, Kompozycji i Teorii Muzyki, Akademia Muzyczna im. S. Moniuszki w Gdańsku, 2017.

Wójcik Jan, *Funkcje korowe* [online], http://www.kognitywistyka.net/mozg/funkcje.html (access: 27.05.2017).