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Relationship between stabilised musical aptitude and harmonic and rhythm improvisation readiness in adults in transversal research

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Abstract

This article is to be considered a research report on the relation between stabilised musical aptitude and harmonic and rhythm improvisation readiness in students of Pedagogy in transversal research. Three tests devised by Edwin Elias Gordon were performed, the first being the *Advanced Measures of Music Audiation* meant to measure the stabilised tonal and rhythm musical aptitude. The second and the third tests measure improvisation readiness. In the case of rhythm improvisation, it was the *Rhythm Improvisation Readiness Record*, and for harmonic improvisation – the *Harmonic Improvisation Readiness Record*. The research was performed on a group of 869 students of Pedagogy with various academic backgrounds in Poland. The results clearly indicate that musical aptitude in the investigated group is at average and low levels. There are also significant statistical relationships between musical aptitude and improvisation readiness, especially the harmonic one.

Keywords: stabilised musical aptitude, rhythm and harmonic improvisation readiness, music learning theory, audiation.

Preliminary assumptions: theoretical background of the research

The constructional core of the presented empirical research is the music learning theory devised by Edwin Elias Gordon and the knowledge concerning the

structure and properties of musical aptitude and audiation. The music learning theory combines the knowledge on learning music in a sequential manner with what we know about musical aptitude and audiation[1], and thus fits into a system of well-defined concepts, such as *stabilised musical aptitude* and *harmonic and rhythmic improvisation readiness*, which are at the same time the object of this research. The aim of the research is to diagnose musical aptitude and musical improvisation readiness (harmonic and rhythmic) in adult students and to search for relationships between these constructs by means of statistical analyses. The highlighted problem remains in the area of predilection of some researchers[2] from the field of music pedagogy, who seek a place and identity for the music learning theory of Edwin E. Gordon, within the framework of pedagogical sciences and – determined by the evolution of science – the multiplication of arguments for the validity of modernizing musical education seen as universal, with audiation[3] in the background. Susan Hallam[4] places music learning within the area of cultural and creative competence acquisition[5], which results in her interest in the two factors (musical aptitude and musical improvisation readiness) coming directly from Edwin E. Gordon's music learning theory, which is empirical and as such, according to the descriptive concept of science, has a descriptive function, where it is assumed that theoretical theorems are translatable into theorems concerning

[1] E.E. Gordon, *Sekwencje uczenia się w muzyce. Umiejętności, zwartość i motywy*, Wydawnictwo WSP, Bydgoszcz 1999, p. 50. See also: E.E. Gordon, *The manifestation of developmental music aptitude in the audiation of "same" and "different" as sound in music,* GIA Publications, Inc., Chicago 1981.

[2] I mainly mean Ewa A. Zwolinska, Beata Bonna, Paweł A. Trzos, Małgorzata Suświłło, Maciej Kołodziejski and Barbara Pazur.

[3] Audiation is, to put it simply, "musical thinking", because it is to music, what thinking is to language. One can audiate, i.e. consciously think musically, by performing various musical activities – from listening, playing, performing, and interpreting to creating, composing and improvising music. Listening with understanding both to music and speech (conversations, dialogues) entails similar operations consisting in decoding the meaning of words/motifs/sentences. More: E.E. Gordon, *Sekwencje uczenia się w muzyce...*, pp. 21–46.

[4] The study of musical aptitude in relation to musical improvisation readiness is autotelic in nature, but it also constitutes a background for questions concerning the influence of music on human functioning. Susan Hallam demonstrates the multiple effects of musical aptitude and achievements on language development, literacy and numeracy, intelligence, overall performance, creativity, motor coordination, concentration, self-confidence, emotional sensitivity, social skills, teamwork, discipline and relaxation. She also suggests that the positive impact of engaging in music activities on personal and social development can only be achieved if it is a pleasant and rewarding experience. However, all this has an impact on the quality of music teaching. Qtd. in: S. Hallam, *The power of music: Its impact on the intellectual, social and personal development of children and young people*, "International Journal of Music Education" 2010, vol. 28, no. 3, pp. 269–289.

[5] Qtd. in: B. Bonna, *Zdolności i kompetencje muzyczne uczniów w młodszym wieku szkolnym*, UKW, Bydgoszcz 2016, p. 254.

observable objects and relationships between events[6]. The assumption concerning the egalitarian nature of the music learning theory, according to which all students can learn music, but not all will have the same achievements in this field[7], adopts a specific research and praxeological standpoint, and places the course of music education in:

— cognitive context[8] – according to Barbara Kamińska, the cognitive research in the focuses on the cognitive functioning of human beings in the field of music, on questions concerning the perception of musical elements and structures. Therefore, the area of musical aptitude became a part of the research on the perception of music, and thus a subject of interest of music psychology[9],

— psycho-educational context, i.e. mainly the optimisation of the conditions for reaching the procedural[10] musical knowledge.

Edwin E. Gordon's theory clearly stresses objective audiation (musical thinking), determined mainly by musical aptitude, the essence of which is the conjunction of nature and culture, and the learning processes are determined by the quality and intensity of everyday musical education and stimulation of students' mental development[11]. I assume that the result of the measurement of musical aptitude, as an effect of the conjunction of nature and culture[12], illustrates the influence of these two factors, especially the one of aptitude that Edwin E. Gordon refers to as stabilized[13]. Thus, the basis for successful music learning consists in musical aptitude, i.e. a set of musical capabilities with a dichotomy of tonal versus rhythmic capabilities[14], considered in the subject matter literature as basic (pri-

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[6] Cf. J. Such, M. Szcześniak, *Filozofia nauki*, Wydawnictwo UWM, Poznań 2006, p. 74–75.

[7] E.E. Gordon, *Sekwencje uczenia się w muzyce...*, p. 45.

[8] See: W.A. Stokes, *Is Edwin Gordon's Learning Theory a Cognitive One?*, "Philosophy of Music Education Review" 1996, vol. 4, no. 2, pp. 96–106.

[9] B. Kamińska, *Zdolności muzyczne w ujęciu psychologii muzyki: ewolucja poglądów*, "Studia Psychologica" 2002, no. 3, p. 194.

[10] Procedural knowledge, also known as imperative knowledge, is knowledge used while performing specific tasks, because it can be directly applied to the solution of a selected problem, and is constructed through action. See more: D.J. Elliott, *Music as Knowledge*, "The Journal of Aesthetic Education" 1999, vol. 25, no. 3: *Special Issue: Philosophy of Music and Music Education* (Autumn 1991), pp. 21–40.

[11] Ibid., p. 46.

[12] E.E. Gordon, *Society and Musical Development*, Another Pandora Paradox, GIA Publications, Inc., Chicago 2010, p. 76.

[13] Stabilized means fixed (well-established, stable, unchanging, constant). Stabilized aptitude is one that has passed from a developing (dynamic) state to a static (relatively stable) state, lasting from about the age of 9 to late old age. This means that from that moment on, there are usually no further qualitative and quantitative changes of a progressive nature, therefore, all measures which are to stimulate the musical potential of a person should be intensified from birth to about the age of 9. See more: E.E. Gordon, *Sekwencje uczenia się w muzyce…*, p. 69–75.

[14] This is because the conclusions drawn from the subject matter literature seem to be consistent with the view that there are two innate factors leading to the acquisition of musical aptitude – one related to the perception of musical time intervals, i.e. rhythm, and the other to the percep-

mary)[15]. Musical aptitude is to be measured using standardised tools in the form of appropriate tests of musical aptitude.

Stabilized musical aptitude and measurement techniques

Musical aptitude and achievements are drastically different from each other, but at the same time closely related[16]. Musical aptitude is a measure of the potential to learn music, i.e. to acquire specific music achievements, such as singing, playing instruments or improvising music. Music achievements, on the other hand, are a measure of what a person has learned[17]. There is a difference between musical aptitude and music achievements, and it is precisely the problem in defining these concepts that usually leads to misidentification, as the difference between them is blurred by the synonymous use of terms such as: *aptitude, capability, talent, musicality, predisposition.* This is becoming a serious problem, especially for music teachers, as traditional teaching approaches clearly reduce individual differences between students[18]. The fact that we are born with equal rights does not mean that we are equal in terms of our aptitude, intelligence and achievements. Just as developing musical aptitude[19] is characterized by fluctuation, because we cannot predict the influence of the environment on its quality, dynamics and level, a stabilized musical aptitude is characterized by durability, unchangeability and finality. One thing is certain. During the first nine years of life, developing musical aptitude is subject to constant change, increase and decrease, depending on the quality of cultural influences[20], and the stabilisation of aptitude means only that the level of musical aptitude (tonal and rhythmic) after the age of nine will remain at the same throughout the course of life[21]. That is why all positive educa-

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tion of pitch – melody. Qtd. in: U. Skupio, *Muzyka a mózg*, "Wszechświat" 2013, vol. 114, no. 10–12, p. 347.

[15] Cf. E.E. Gordon, *A Music Learning Theory for Newborn and Young Children,* G. I. A. Publications, 1990; idem, *Sekwencje uczenia się w muzyce...*; B. Bonna, *Zdolności i kompetencje muzyczne uczniów w młodszym wieku szkolnym*, UKW, Bydgoszcz 2016; P. Trzos, *Umiejętności audiacyjne uczniów na etapie edukacji wczesnoszkolnej*, UKW, Bydgoszcz 2018. See also research on tonal aptitude correlation in: E.A. Zwolińska, D. Mikołajewski, P.A. Trzos, *Efficiency of Listening to the Melody and Neural Correlates of Tonality Differentiation*, "Israel Studies in Musicology Online" 2019, vol. 16, pp. 44–57.

[16] V. Valerio, *The Gordon Approach: Music Learning Theory*, qtd. in: https://www.allianceamm.org/resources/gordon/ [accessed Sep 8, 2019].

[17] E.E. Gordon, *Nature, source, measurement, and evaluation of music aptitudes*, "Polskie Forum Psychologiczne" 2006, vol. 11, no. 2, pp. 227–237.

[18] Ibid., p. 10–11.

[19] More on this topic: D.L. Walters, *Edwin Gordon's Music Aptitude Work*, "The Quarterly" 1991, no. 2(1–2), pp. 64–72.

[20] E.E. Gordon, *Sekwencje uczenia się w muzyce…*, p. 72.

[21] Ibid.

tional efforts which allow for musical aptitude to be stimulated are so important in the period of their malleability[22], i.e. infancy, preschool and early school age.

The premise – by E.E. Gordon – that everyone has the potential to learn music is still valid[23]. By using tests, teachers can try to predict students' musical potential and measure their music achievements more accurately[24]. The researchers' responsibilities should be focused on undertaking an intellectual (scientific, polemical) dispute with the stereotype of a subjective method of diagnosing musical aptitude, present in the social awareness (typical of teachers of early music education and music), where the majority of teachers are sceptical of objective information obtained by testing[25]. The source of this state of affairs is the reliance on subjective assessments[26] (class observation, aural analyses, auditions), sanctioned by teaching tradition and social consent, instead of objective measurement[27] in line with the principle that "the test sees what the teacher does not hear"[28]. Adopt-

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[22] See more on the topic of developing aptitude measurement: E.E. Gordon, *A Factor Analysis of the Musical Aptitude Profile, the Primary Measures of Music Audiation, and the Intermediate Measures of Music Audiation*, "Bulletin of the Council for Research in Music Education" 1986 (Spring), no. 87, pp. 17–25.

[23] E.E. Gordon, *Aspects of Validity the Harmonic Improvisation Readiness Record and Rhythm Improvisation Readiness Record: Evidence of Music Aptitude and Achievement*, [in:] *Test Validity and Curriculum Development. Three Longitudinal Studies in Music*, GIA Publications, Inc., Chicago 2001, pp. 11–12.

[24] A.M. Reynolds, *Understanding Music Aptitude: Teachers' Interpretations*, "Research Studies in Music Education" 2004, no, 23, p. 18.

[25] Others (a small percentage) appreciate the opportunity, but treat the data obtained in this fashion in a superficial and inconsistent way, e.g. in the case of decisions on teaching based on individual differences. Other teachers use tests, interpreting their results inconsistently, mainly because of internal (emotional and mental) blockages to adopting the appropriate theoretical and philosophical perspective, teaching experience or general understanding of the structure and objective of the test. Such a theoretical perspective can be e.g. praxeological, because the object of human interest (teacher) consists in intentional and conscious actions. The awareness of a specific perspective leads to a specific action aimed at achieving a goal, e.g. increasing improvisation readiness or increasing the children's music achievements in the area of musical improvisation.

[26] It also seems that information about aptitude and improvisation readiness (harmonic and rhythmic) acquired in an objective way may determine the change of the teaching perspective from the so-called "dispersed" to the "structured" one, which must give rise to certain causative consequences. According to Christopher A. Mitchell, "It is essential for [...] teachers to have as much information about their students' musical abilities [e.g. vocal or improvisational] as possible in order to provide each student with the type of instruction most needed". Ch.A. Mitchell, *Audiation and the Study of Singing*, Electronic Theses, Treatises and Dissertations, The Graduate School Florida State University Libraries 2007, p. 27.

[27] A.M. Reynolds, *Understanding Music Aptitude: Teachers' Interpretations*, "Research Studies in Music Education" 2004, no, 23, p. 18.

[28] M. Kołodziejski, *"Jest już za późno! Nie jest za późno!" – czyli uwag kilka o naturze, strukturze i właściwościach zdolności muzycznych dzieci w wieku przedszkolnym i młodszym szkolnym*, [in:] *Pedagogika i jej oblicza*, ed. J. Skibska, J. Wojciechowska, Wydawnictwo Naukowe ATH, Bielsko-Biała 2018, pp. 425–450.

ing such a way of thinking means adopting a specific research and evaluation perspective[29], i.e., as Jacek Piekarski rightly states: "[...] research is a kind of social practice, where the quality of researchers' participation in said practices becomes a special area of concern and interest"[30].

Current research on the relationship between musical aptitude and improvisation readiness (harmonic and rhythmic)

Edwin Elias Gordon was a pioneer of correlation studies between musical aptitude (both developing and stabilized) and harmonic and rhythmic improvisation readiness. What follows illustrates the correlation values between the indicated constructs in adults (Table 1)[31].

Table 1. The relationship between musical aptitude measured with AMMA test and improvisation readiness (measured with HIRR and RIRR tests) in Edwin E. Gordon's research.

	RIRR	**HIRR**	**Tonal (AMMA)**	**Rhythmic (AMMA)**	**Overall result (AMMA)**
RIRR	—	0.32	0.21	0.24	0.24
HIRR		—	0.28	0.26	0.29
Tonal (AMMA)			—	0.68	0.90
Rhythmic (AMMA)				—	0.91

Source: E.E. Gordon, *Harmonic Improvisation Readiness Record and Rhythm Improvisation Readiness Record*, GIA Publications, Inc., Chicago 1998, p. 58.

In other studies using the *Musical Aptitude Profile* (MAP) test battery, Edwin E. Gordon shows a Pearson's *r*-correlation of 0.37 to 0.66 between the individual results of the MAP aptitude test and harmonic improvisation readiness measured by the HIRR test[32]. Calculations of the relationship between musical aptitude and rhythmic improvisation readiness, measured by the AMMA test on 33 students of Pedagogy in the field of early education, showed (in the research of Maciej Kołodziejski) values at the level of $r = 0.19$, but they were not statistically signif-

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[29] I see evaluation as a regular inquiry into the value of one's own work.

[30] J. Piekarski, *Perspektywa uczestnicząca w badaniach empirycznych – zarys tematyczny,* „Przegląd Badań Edukacyjnych" 2017, no. 25 (2/2017), p. 269.

[31] Unfortunately, it is not known whether all calculations are statistically significant, but it should be expected that higher *r*-factors will certainly have a statistical significance of at least $\alpha \leq 0.05$.

[32] Qtd. in: G. Comeau, *Piano Pedagogy: A Research and Information Guide*, 1st Edition, Routlege, London – Ottawa 2009, pp. 141–142.

icant[33]. A study of the relationship between the results of the AMMA test and rhythmic improvisation readiness on 33 students of early education pedagogy, conducted by Maciej Kołodziejski, showed values at the level of $r = 0.19$, which were not statistically significant. In other research explorations on a similar topic (where $N = 33$) a correlation of $r = 0.42$ between RIRR and AMMA results was found[34]. A study of the relationship between stabilized musical aptitude and rhythmic improvisation readiness (RIRR) showed a correlation of $r = 0.20$[35].

Research assumptions

In order to capture the relationship between stabilized musical aptitude and harmonic and rhythmic improvisation readiness, a diagnostic[36]-verification[37]-correlation[38] research model was applied, with an *etic* quantitative strategy and research orientation rooted in the neopositivist paradigm with a testing method[39]. The main premise of this approach is to strive for objectivity and axiological neutrality, thanks to which the researcher becomes an external and uninvolved observer who tries to distance themselves from the reality being researched, which exists objectively and should be reflected in the research process based on scientific methods (here testing)[40], where the basic methods of developing and analys-

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[33] M. Kołodziejski, *Zdolności muzyczne ustabilizowane a imitacja i improwizacja rytmiczna w metrum dwudzielnym studentów wczesnej edukacji w badaniach własnych*, "Edukacja Elementarna w Teorii i Praktyce" 2018, vol. 13, no. 2(48), p. 153.

[34] Idem, *Rhythmical Creativity in Duple and Triple Meter of Students of Early-School Education in the Light of Their Stabilised Musical Aptitudes and Rhythm Readiness to Improvise*, "Review of Artistic Education" 2018, no. 15(1), p. 20.

[35] Idem, *Poziom zdolności muzycznych ustabilizowanych a gotowość do improwizacji harmonicznej i rytmicznej u studentów pedagogiki*, [in:] *Twórczość "codzienna" w praktyce edukacyjnej*, ed. M. Kołodziejski, Wydawnictwo PWSZ, Płock 2009, pp. 91–108.

[36] Diagnostic research consists in taking reliable measurements and determining the level of musical aptitude (tonal, rhythm and overall), as well as harmonic and rhythmic improvisation readiness.

[37] The purpose of verification research is to confirm (or deny) a given state of affairs within the phenomena being researched and, what is important, compare the findings in reference to the initial scientific theory, here – the music learning theory by Edwin Elias Gordon, and verify the theoretical and practical assumptions of AMMA, HIRR and RIRR tests by E.E. Gordon. See J. Apanowicz, *Metodologia ogólna*, Gdynia 2002, p. 36.

[38] The correlational research model is mainly meant to test the research hypothesis concerning the strength and direction of the relationship between the studied variables, here – between musical aptitude and harmonic and rhythmic improvisation readiness. In other words, this procedure is aimed at determining the interdependence and covariability of the studied phenomena. See E.E. Gordon, *Designing Objective Research in Music Educaation. Fundamental Considerations*, GIA Publications, Inc., Chicago 1986, pp. 28–29.

[39] PQStat software was used for statistical calculations.

[40] See more in: Ł. Sułkowski, *Metodologie emic i etic w badaniach kultury w zarządzaniu*, "Management and Business Administration. Central Europe" 2012, vol. 108, no. 1/2012, pp. 65–66.

ing the research material should include a wide spectrum of statistical proce-
dures[41]. This model of research, adopted in Edwin E. Gordon's scientific method-
ology, is characterised by a pursuit of generalisation, objectivity and a more uni-
versal reference framework[42].

A total of 869 Pedagogy students (adults) from the years 2008-2019 and from
various academic centres in Poland (Płock, Tomaszów Mazowiecki, Jelenia Góra, Ol-
sztyn, Pułtusk, Bydgoszcz, Częstochowa, Kalisz and Skierniewice), coming from the
so-called non-musical groups, were enrolled in the study using standardised test tools.
The selection of the sample was intentional, mainly because of the community in ques-
tion being easily accessible. Three standardised tests were used: *Advanced Measures
of Music Audiation*, AMMA[43], measuring the two basic components of musical apti-
tude – tonal and rhythmic hearing, Edwin Elias Gordon's *Harmonic Improvisation
Readiness Record* (HIRR)[44] and *Rhythm Improvisation Readiness Record*[45]

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[41] The following statistical procedures were used here: basic descriptive statistics of quantitative
data, distribution study using the Kolmogorov-Smirnov (K-S) test, average comparison using
the *Student's t-test* for dependent and independent groups, Spearman's linear *r* correlation.

[42] E.E. Gordon, *Designing objective research in music education*, GIA Publications Inc., Chicago
1986; see also: M. Raiber, D. Teachout, *The Journey from Music Student to Teacher: A Profes-
sional Approach*, Routledge, London 2013.

[43] The AMMA test was published in 1989 and designed for adults at the request of the National
Association of Schools of Music in the USA, intended for use by higher education institutions. See
E.E. Gordon, *Continuing Studies in Music Aptitudes*, GIA Publications, Inc., Chicago 2004, p. 7.

[44] The HIRR test is intended for children and adults of all ages. The aim of HIRR is to help teachers
to objectively determine the necessary readiness of students/adults to learn harmonic improvi-
sation, and to help them adapt their curricula to the individual differences between students while
learning musical (harmonic) improvisation. This 17-minute group test consists of 43 harmonic
tasks that are performed in different tonalities (music scales). Each task consists of three chords,
all of equal duration, with a tonic chord as the first and last chord in C major. All instructions
on how to perform the test with the exercises (examples) are included on the CD recording.
Students are required to listen to pairs of harmonic tasks and to check the correct box on the
answer sheet (whether the two chords in each pair sound the same or different). If students are
unsure of the correct answer, they are requested to check the question mark column, which in-
dicates that they have doubts. Qtd. in: E.E. Gordon, *Music Aptitude and Related Tests. An In-
troduction*, GIA Publications, Inc., Chicago 2001, p.14.

[45] Similarly, the RIRR test is designed for children and adults of all ages. The aim of this tool is to
help the teacher to objectively determine the necessary readiness of students to learn rhythmic
improvisation, and to help them adapt the curricula to the individual differences between stu-
dents while learning musical (rhythmic) improvisation. An additional advantage of the test is
that it shows whether the student has the ability to accurately handle temporal relationships in
music. This 20-minute group test consists of 40 pairs of rhythmic tasks, each pair performed
using the same simple melodic line in C major. Each melodic line contains only four simple
rhythmic values. Instructions on how to perform the RIRR test with sample exercises can be
found on the CD. Students are asked to listen to pairs of patterns and to indicate on the answer
sheet whether the two patterns are the same or different. If the two patterns do not sound the
same, it means that in the second pattern, the duration is longer or shorter than in the first pattern.
For the sake of psychological comfort of the students, they have the option to mark a column

(RIRR)[46]. All the tools used are relatively short in duration and it takes no more than 30 minutes to carry out efficient measurement operations during a single meeting. Environmental and birth factors (pheno- and genotype, respectively), the impact of family interactions quality, pre-school and school education, as well as extracurricular activities were set as an independent variable[47]. In the case of the AMMA test, the dependent variable was limited to measuring the melodic (tonal), rhythm and overall musical aptitude, as well as the harmonic (HIRR test) and rhythmic (RIRR test) improvisation readiness or lack thereof. The indicators for the dependent variable are three AMMA results: tonal, rhythm and overall, and two raw results, one for the HIRR and one for the RIRR test.

The main problem of the research was in the following question:

What are the relationships between stabilized musical aptitude and harmonic and rhythmic improvisation readiness of the studied group of adults representing the environment connected with studying at pedagogical faculties?

The following questions were identified as specific problems:

1. What is the level of stabilized musical aptitude in adults representing the environment related to the field of pedagogy?
2. Which type of musical aptitude, tonal or rhythm, reach higher values in the obtained measurements?
3. What are the intercorrelations between the results obtained in the tonal (melodic) and rhythm aptitude subtests, and the overall result within the context of the previous research on musical aptitude in different cultural environments?

Descriptive statistics for stabilized musical aptitude in the studied group of pedagogy students

The zero hypothesis, concerning the occurrence of a normal distribution of the dependent variable (both musical aptitude and musical improvisation readi-

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with a question mark if they are not sure of the correct answer. Qtd. in: E.E. Gordon, *Music Aptitude and Related Tests. An Introduction*, GIA Publications, Inc., Chicago 2001, p. 15.

[46] E.E. Gordon, *Harmonic Improvisation Readiness Record and Rhythm Improvisation Readiness Record*, GIA Publications, Inc., Chicago 1998.

[47] This requires the measurement of music aptitude regardless of the formal musical preparation of the participants. The testing tool must not adhere to rules similar to the design of music achievements tests. In other words, in order to assess the music learning potential in students, they cannot be expected have received formal musical education. Therefore, the design of the test should eliminate the participants' knowledge of musical notation, musical terminology and any theoretical knowledge, and such is the case of this study, where the examined cases have neither formal nor informal musical preparation. In other words, they have never participated in any specialised classes aimed at developing musical skills and aptitude. Qtd. in: Ch.A. Mitchell, *Audiation and the Study of Singing*, Electronic Theses, Treatises and Dissertations, The Graduate School Florida State University Library 2007, p. 27.

ness) in the studied group of 869 students, was confirmed because the calcula-
tions using the Kolmogorov-Smirnov (K-S)[48] test were equal to, respectively: for
musical aptitude $D = 0.045486$ for $\alpha \leq 0.05$, where $p = 0.053194$; rhythmic im-
provisation readiness $D = 0.100649$ for $\alpha \leq 0.05$, where $p = 0.301071$; harmonic
improvisation readiness $D = 0.103556$ for $\alpha \leq 0.05$, where $p = 0.270217$. This is
illustrated by the following example of a bar chart for a dependent variable *mu-
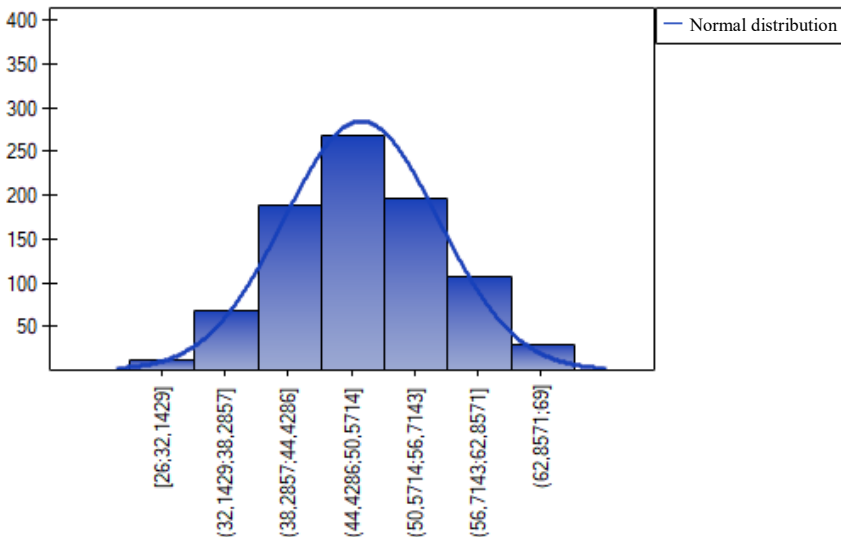sical aptitude* (Fig. 1).

Figure 1. Cumulative distribution function for the normal distribution of *stabilized musical aptitude*
measured by E.E. Gordon's AMMA test in a group of adults (students of pedagogy).

Source: own elaboration.

At the same time the values of the dependent variable are located along the
line of fit on the quantile-quantile plot, and this indicates a good profile of the
normal distribution of the considered attribute (*musical aptitude*). The graphical
fitting of the attribute to the distribution is illustrated in the next chart (Fig. 2).

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[48]   The calculation procedure for the Kolmogorov-Smirnov test for one sample allows to compare
the observed cumulative distribution function for a variable (here stabilized musical aptitude)
with the specific theoretical normal distribution. The Z-value of the Kolmogorov-Smirnov test
is calculated based on the greatest difference (in absolute values) between the observed and
theoretical cumulative distribution functions. This test checks whether the observations can
come from a given distribution. For a normal distribution, the parameters are the average of the
sample and the standard deviation. Qtd. in: https://www.ibm.com/support/knowledge-
center/pl/SSLVMB_sub/statistics_mainhelp_ddita/spss/base/idh_ntk1.html [accessed Oct 17,
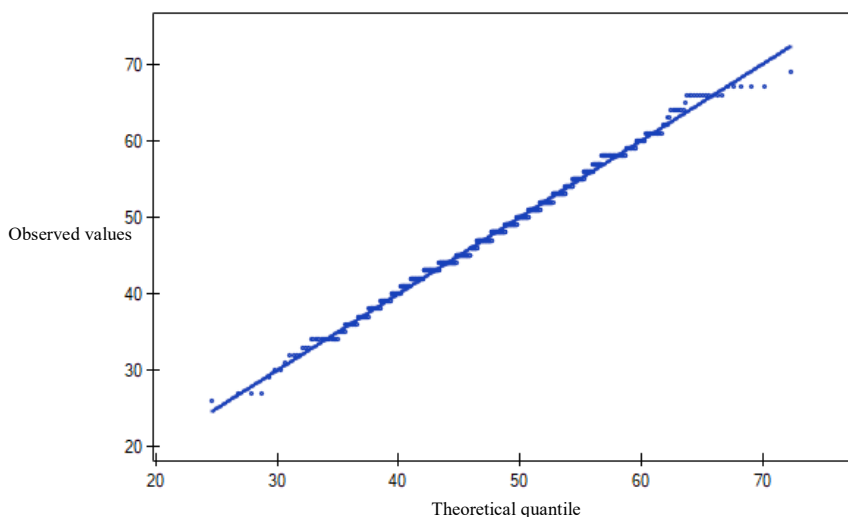2019].

Figure 2. The line of fit of the dependent variable (stabilized musical aptitude) in relation to the normal distribution (quantile-quantile)

Source: own elaboration.

A low arithmetic mean of overall stabilized musical aptitude is noticeable (at the level of $M = 48.47$, in the tonal result $M = 23.20$, and in the rhythm result $M = 25.28$). The median value of the AMMA score, i.e. the median of the second quartile, was $Me = 48$ ($Me = 23$ for the tonal subtest, and $Me = 25$ for the rhythm subtest). At the same time, the mode of the results for overall musical aptitude result was $Mo = 44$, $Mo = 23$ for tonal aptitude, and for rhythm aptitude only $Mo = 24$. The following table shows the detailed AMMA test data obtained using statistical tests (Table 2).

Table 2. Descriptive statistics for the results obtained in the E.E. Gordon's AMMA test in the studied group of adults (students of pedagogy)

Variables analysed (869 surveyed)	Tonal	Rhythm	Overall result
Relevance level	0.05	0.05	0.05
Arithmetic mean	23.20	25.28	48.47
Median	23	25	48
Mode	23	24	44
Mode count	115	99	55
Minimum	11	13	26
Maximum	35	35	69
Lower quartile	21	22	44
Upper quartile	26	28	53

Source: own elaboration.

The level of stabilized musical aptitude was determined based on percentile standards which are an inseparable part of Edwin E. Gordon's AMMA test[49]. Percentiles (or centiles) are defined as measures of the average positions defining a statistical population, regardless of the differences between its individual elements. The percentile measures the concentration of elements in terms of percentages, dividing the population into 100 equal parts. Based on this measurement, for any number of observations of an ordered population it is possible to determine the percentage of the population above or below such an observation[50]. It turns out that the studied group of 869 students of pedagogy is characterized by average (84.7%) and low (12.4%) levels of stabilized musical aptitude. Only 2.9% of the studied population have overall musical aptitude within the high range, i.e. between 80 and 99 percentiles[51]. A low level of tonal aptitude was observed in a significant group of subjects, i.e. ≤ 20 percentile (108 students, i.e. 12.4%), along with rhythm aptitude (150 students, i.e. 17.2%) and musical aptitude in the overall result (138 students, i.e. 15.9%). A higher number of students with a low level of rhythm musical aptitude (rhythm: 150 students, tonal: 108 students) was recorded, despite a higher mean value in this area in comparison to the tonal subtest (tonal: $M = 23.20$, rhythm: $M = 25.28$). Similar results were observed in the case of students with high musical aptitude, where ≥ 80 percentile there was only a minuscule group of students with tonal aptitude (25 students, i.e. 2.9%), rhythm aptitude (27 students, i.e. 3.1%) and with an overall test result (29 students, i.e. 3.3%). This is illustrated by the bar chart (Fig. 3).

	Tonal	Rhytm	Total
Low	12,4	17,2	15,9
Average	84,7	79,7	80,8
High	2,9	3,1	3,3

Figure 3. Level of *stabilized musical aptitude* in the studied group

Source: own elaboration.

[49] E.E. Gordon, *Manual for the Advanced Measures of Music Audiation,* GIA Publications, Inc., Chicago 1989, pp. 28–31.
[50] See more: A. Zimny, *Statystyka opisowa*, Wydawnictwo PWSZ, Konin 2010, p. 22.
[51] Cf. E.E. Gordon, *Jump Right In: The Music Curriculum, Reference Handbook for Using Learning Sequence Activities*, GIA Publications, Inc., Chicago 2001.

At the same time, a higher number of students with a high musical aptitude for rhythm is observed, which is confirmed by further statistical inference. The comparison of the mean values of tonal ($M = 23.20$; $SD = 3.99$) and rhythm ($M = 25.28$; $SD = 3.94$) aptitude using the Student's *t*-test (parametric test) for $\alpha \leq 0.05$ for *t*-statistic $= -18.955031$ showed a statistically significant difference (mean difference -2.0; with a standard error of the difference of 0.1097 and a common $SD = 3.23$) of $p = 0.000001$ in favour of the rhythm subtest[52]. This is illustrated by the graph below (Fig. 4).
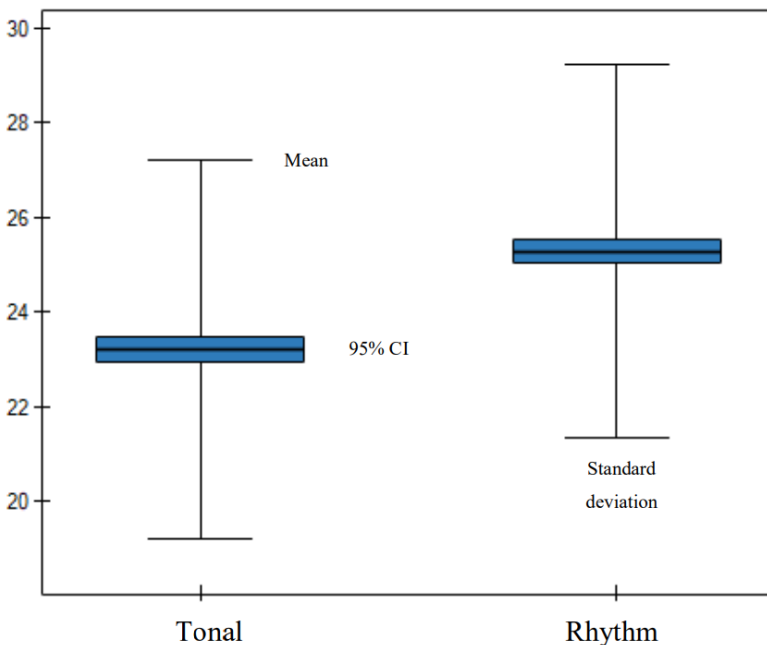

Figure 4. Comparison of the results of the dependent variable *tonal aptitude* vs. *rhythm aptitude*

Source: own elaboration.

Evidence was provided, relevant from the standpoint of AMMA test sensitivity, demonstrating an intercorrelation between tonal, rhythm, and overall aptitude measured with Pearson's linear dependence test, where:

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[52] However, the data obtained cannot be considered optimistic, as the study shows only a downward trend in the measured construct, which is musical aptitude. The mean values obtained unequivocally support the argument that a change in musical education of children is necessary, because while the musical aptitude of students finishing the first stage of education does not differ from the theoretical normal distribution in expected values, i.e. 16% low, 16% high and 69% average, in adults, despite the empirical normal distribution of *musical aptitude* calculated using the Kolmogorov-Smirnov (K-S) statistical test, average and low values of musical aptitude prevail.

— between the melody and rhythm subtest $r = 0.66$, where $p = 0.00001$ for $\alpha \leq 0.05$, which means the correlation is strong and statistically significant,
— between the melody subtest and the overall musical aptitude result $r = 0,89$, where $p = 0,00001$ for $\alpha \leq 0,05$, which means the correlation is very strong and statistically significant,
— between the rhythm subtest and the overall musical aptitude result $r = 0.88$, where $p = 0.00001$ for $\alpha \leq 0.05$, which means the correlation is very strong and statistically significant.

Analysis of the results of musical improvisation readiness tests (harmonic and rhythmic)

Improvisation readiness was calculated on the basis of Edwin E. Gordon's HIRR and RIRR test guidelines[53], where in the HIRR test, harmonic improvisation readiness was indicated by a result between 22 and 43 in the raw result, while a result between 8 and 21 indicated a lack thereof. For the RIRR test, rhythmic improvisation readiness was indicated by a result between 22 and 40, while a result between 12 and 21 indicated a lack thereof (Table 3).

Table 3. Harmonic and rhythmic improvisation readiness or lack thereof in research participants, expressed as percentages

$N = 869$	RIRR	HIRR
With readiness to improvise	93.4%	93.4%
Arithmetic mean (m)	29.84	29.6
Without readiness to improvise	6.6%	6.6%
Arithmetic mean (m)	20.16	19.5

Source: own elaboration.

A statistical method in the form of Student's t-test for independent groups was used to compare the averages of the two autonomous test results. No differences were found between mean values obtained in HIRR tests ($M = 29.07$) and RIRR tests ($M = 29.2$) for $\alpha \leq 0.05$, where $p = 0.861414$, where the t-statistic = 0.174827. This means that there are no differences in harmonic and rhythmic improvisation readiness in the studied group, and the readiness itself is characterized by comparable ranges and its level is highly satisfactory. Calculated correlations between RIRR and HIRR tests did not show any statistically significant linear interrelation, because $r = 0.16$ for $\alpha \leq 0.05$, where $p = 0.111521$. See basic statistics for RIRR and HIRR tests in Table 4.
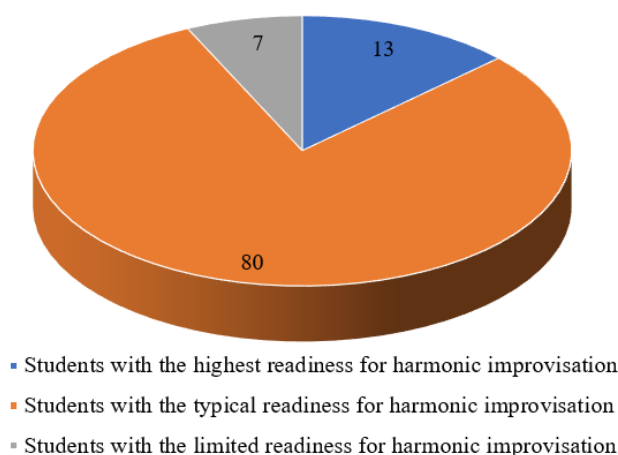
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[53] E.E. Gordon, *Harmonic Improvisation Readiness Record and…*, p. 34.

Table 4. Descriptive statistics for HIRR and RIRR test results (for N = 869)

Variables analysed	HIRR	RIRR
Arithmetic mean	29.0	29.2
Median	29	29
Mode	33	multiple
Standard deviation	4.8	4.5
Minimum	17	19
Maximum	38	38
Lower quartile	26	27
Upper quartile	33	33

Source: own elaboration.

Edwin E. Gordon further encourages the use of information from the analysis of test results for HIRR to design a music learning environment (including harmonic musical improvisation) in heterogeneous groups: 1) with the highest degree of harmonic improvisation readiness, 2) with a typical harmonic improvisation readiness, and 3) with a limited harmonic improvisation readiness. The distribution of harmonic improvisation readiness in terms of group heterogeneity looks as follows (pie chart), where only 7% (i.e. 61 students) have a limited harmonic improvisation readiness ($M = 19.5$), 80% (i.e. 696 students) have a typical (average) harmonic improvisation readiness ($M = 28.6$), and 13% (i.e. 112 students) have the highest harmonic improvisation readiness ($M = 36.2$). This is illustrated by the pie chart (Fig. 5).

- Students with the highest readiness for harmonic improvisation
- Students with the typical readiness for harmonic improvisation
- Students with the limited readiness for harmonic improvisation

Figure 5. Heterogeneity of harmonic improvisation readiness in the studied group ($N = 869$)

Source: own elaboration.

Relationship between stabilized musical aptitude and harmonic and rhythmic improvisation readiness

From the scientific (cognitive) standpoint, the search for relationships between variables falls within the model of correlational research, which are directly related to the correlation coefficient, or a certain statistical measure, which determines the direction and strength of the relationship between, most frequently, two variables (here, *stabilised musical aptitude and musical improvisation readiness*). Both dependent variables belong to an array of notions connected with the theory of music learning, so the presented research scheme falls within the verification-correlation model. Due to the normal cumulative distribution function of the distribution, the Pearson's *r*-correlation test (also referred to as linear correlation coefficient) is used as the correlation coefficient in the calculations. From an educational point of view, familiarity with practical test parameters leads to better decision making related to the optimization of processes of music teaching and learning; here – based on the simple positive correlation between the *musical aptitude* variable and *musical improvisation readiness* (*harmonic or rhythmic*), where $r > 0$. In the relations discussed above, an increase in *musical aptitude* (both tonal and rhythm subtest) is accompanied by a significant increase in *harmonic improvisation readiness* (tonal subtest: HIRR $r = 0.38$; rhythm subtest: HIRR $r = 0.51$; AMMA overall result: HIRR $r = 0.48$). This is illustrated in the table 5.

Table 5. Pearson's *r*-correlation between *stabilised musical aptitude* measured by AMMA test and *harmonic* (HIRR test), and *rhythmic improvisation readiness* (RIRR test)

	HIRR	p (for $\alpha \leq 0.05$)	**RIRR**	p (for $\alpha \leq 0.05$)
Tonal	**0.38**	0.000174	0.11	0.274407
Rhythmic	**0.51**	<0.000001	0.13	0.193974
Total AMMA	**0.48**	0.000002	0.14	0.169105

Source: own elaboration.

Statistically significant relationships were noted between the individual aptitude types observed in the AMMA subtest results and the results obtained in the HIRR test, which are particularly relevant between *rhythm aptitude* and *harmonic improvisation readiness,* where $r = 0,51$, which indicates a high correlation and a strong interrelation (for $\alpha \leq 0,05$, where $p < 0,000001$), as well as between the overall *stabilised musical aptitude* result obtained in the AMMA test and the HIRR test score, where $r = 0,48$ (for $\alpha \leq 0.05$, where $p < 0.000002$).

Summary and conclusions

— stabilised musical aptitude still[54] remains mainly at an average and low level,
— in the phase of stabilised musical aptitude, rhythm aptitude is at a higher level than tonal aptitude, which has been confirmed by the research results to date,
— intercorrelations between the AMMA test results (tonal, rhythm and overall) show high *r*-values, thus significantly increasing confidence in the proposed research tools, the predictive power of which remains evident and undisputed, especially with reference to musical aptitude and certain musical achievements (e.g. vocal, improvisation) extrapolation,
— musical improvisation readiness in the research participants is mostly at a level that enables them to start the process of acquiring musical improvisation abilities. Improvisation gives a lot of satisfaction, but most of all it develops musical hearing (harmonic, tonal and rhythmic), helps to recognize and move through different scales and modes (from Major, Dorian, Phrygian, Lydian, Mixolydian, Aeolian, Minor, Harmonic to Locrian), prepares students for audiation through anticipation while improvising music, allows for self-expression, increases creativity, improves health, strengthens the ability of active listening, gives pleasure and motivates to take action,
— only 7% of the adult research participants have limited harmonic improvisation readiness, while as much as 80% have typical readiness (average), only 13% have the highest readiness ($M = 36.2$), which means that a hypothetical process of working with such students should be justified from an educational standpoint by a specific selection of musical material (musical content) and teaching methods while at the same time considering the individual musical differences in the adaptation of musical content when teaching takes place in a group[55]. At the same time, it should be considered optimistic that as many as 90% of the respondents possess the necessary readiness described above at an average (typical) and high level, meaning that the only obstacle in developing improvisation abilities continues to be the "fossilized" education system (systemic and program factors), educational philosophy (transmission and encyclopaedic approach to teaching and learning processes), lack of internal motivation (mental inhibitors) and insufficiently prepared teaching staff (pedeutological),
— statistically significant (for $\alpha \leq 0.05$) relations were observed between musical aptitude (tonal, rhythm and overall measured by E.E. Gordon's AMMA test) and harmonic improvisation readiness (measured by the HIRR test),

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[54] Still, because in the research conducted by the author for over 10 years, these values have remained unchanged, particularly in relation to stabilised musical aptitude; see M. Kołodziejski, *Stabilised musical aptitudes of the school and academic youth in transversal research*, "Społeczeństwo i Rodzina" 2017, vol. 52, no. 3/2017, pp. 7–24.

[55] E.E. Gordon, *Harmonic Improvisation Readiness Record, and…*, pp. 42–43.

where tonal aptitude: HIRR, $r = 0.38$, rhythm aptitude: HIRR, $r = 0.51$ and AMMA overall result: HIRR, $r = 0.48$, which indicates explicated moderate and strong linear relationships between the measured quantitative variables at a cumulative distribution function for the normal distribution which is significant for an empirical explanation. As the correlation does not directly indicate causal relationships, and we assume that stabilized aptitude is not subject to stimulation, then positive coexistence (correlation) indicates only that high values of the dependent variable *musical aptitude* correspond to high values of the dependent variable *harmonic improvisation readiness*, meaning that these variables merely coexist. The consequence of this is an adequate interpretation of the results obtained in educational practice, where we can assume that people with high musical aptitude are characterized by high readiness to undertake harmonic improvisation.

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Maciej KOŁODZIEJSKI

Karkonoska Państwowa Szkoła Wyższa w Jeleniej Górze

Zdolności muzyczne ustabilizowane a gotowość do improwizacji harmonicznej i rytmicznej u osób dorosłych w badaniach transwersalnych

Streszczenie

Niniejszy artykuł stanowi rodzaj komunikatu badawczego na temat relacji między zdolnościami muzycznymi ustabilizowanymi a gotowością do improwizacji harmonicznej i rytmicznej u studiujących na kierunku pedagogika; wyniki uzyskano w badaniach transwersalnych. Zastosowano trzy testy autorstwa Edwina Eliasa Gordona: pierwszy to *Advanced Measures of Music Audiation* przeznaczony do badania ustabilizowanego uzdolnienia muzycznego tonalnego i rytmicznego, drugi i trzeci to testy mierzące gotowość do podejmowania improwizacji; w przypadku improwizacji rytmicznej był to test o nazwie *Rhythm Improvisation Readiness Record*, a harmonicznej – *Harmonic Improvisation Readiness Record*. Badania przeprowadzono na grupie 869 studentów pedagogiki pochodzących z różnych środowisk akademickich Polski. Wyniki badań pokazują wyraźnie, że uzdolnienia muzyczne badanych występują na przeciętnym i niskim poziomie. Odnotowuje się także istotne związki statystyczne między uzdolnieniem muzycznym a gotowością do improwizacji, głównie harmonicznej.

Słowa kluczowe: zdolności muzyczne ustabilizowane, gotowość do improwizacji rytmicznej i harmonicznej, teoria uczenia się muzyki, audiacja.