Research, Society and Development, v. 11, n. 11, e53111133331, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i11.33331

Impact of music education on musical perception in professional musicians, amateur musicians, and non-musicians

Impacto da educação musical na percepção musical de músicos profissionais, amadores e não músicos

Impacto de la educación musical en la percepción musical de músicos profesionales, músicos aficionados y no músicos

Received: 07/24/2022 | Reviewed: 08/03/2022 | Accept: 08/05/2022 | Published: 08/15/2022

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Abstract
Musical perception is directly related to music education, which is influenced by several factors. This perception needs to be objectively characterized in the Brazilian population since there is no standard of music education applied equally by different training centers. The objective of the present study was to evaluate the musical perception of the Brazilian population through the Music Ear Test (MET) of professional, amateur, and non-musician musicians. The test effectively separated the group of professional musicians from the other groups. In the group of professional musicians, performance on the rhythmic subtest negatively correlates with age. In the group of amateur musicians, the performance in the melodic subtest was positively correlated with hours of musical study. The group of non-musicians was the only one in which the performance in the two sub-tests, melodic and rhythmic, was positively correlated.
Keywords: Education; Perception; Perception test; Musicians; Musical ability; Teaching.

Resumo
A percepção musical está diretamente relacionada à educação musical, que é influenciada por diversos fatores. Essa percepção precisa ser caracterizada objetivamente na população brasileira, uma vez que não existe um padrão de educação musical aplicado igualmente pelos diferentes centros de formação. O objetivo do presente estudo foi avaliar a percepção musical da população brasileira por meio do Music Ear Test (MET) de músicos profissionais, amadores e não músicos. O teste efetivamente separou o grupo de músicos profissionais dos demais grupos. No grupo de músicos profissionais, o desempenho no subteste rítmico correlaciona-se negativamente com a idade. No grupo de músicos amadores, o desempenho no subteste melódico correlacionou-se positivamente com horas de estudo musical. O grupo de não músicos foi o único em que o desempenho nos dois subtestes, melódico e rítmico, se correlacionou positivamente.
Palavras-chave: Educação; Percepção; Teste de percepção; Músicos; Habilidade musical; Ensino.

Resumen
La percepción musical está directamente relacionada con la educación musical, en la que influyen varios factores. Esta percepción necesita ser caracterizada objetivamente en la población brasileña, ya que no existe un estándar de educación musical aplicado por igual por los diferentes centros de formación. El objetivo del presente estudio fue evaluar la percepción musical de la población brasileña a través del Music Ear Test (MET) de músicos profesionales, aficionados y no músicos. La prueba separó efectivamente al grupo de músicos profesionales de los demás grupos. En el grupo de músicos profesionales, el desempeño en la subprueba rítmica se correlaciona negativamente con la edad.

En el grupo de músicos aficionados, el desempeño en la subprueba melódica se correlacionó positivamente con las horas de estudio musical. El grupo de no músicos fue el único en el que se correlacionó positivamente el desempeño en las dos subpruebas, melódica y rítmica.
Palabras clave: Educación; Percepción; Prueba de percepción; Músicos; Habilidad musical; Enseñanza.

1. Introduction

Understanding the musical abilities of different audiences through people's musical perception through listening tests is a challenging task. The theme is intertwined with other relevant topics, such as music education, to develop a perception in the individual.

Music as an aesthetic experience provides pleasure to those who listen and development to those who perform it. A rich knowledge acquired when handling a score with defined musical structures full of expression, communication and language, through sounds, thoughts and sensations (Brescia, 2011). Often in the process of musical learning, we come across some barriers, among them musical tastes. Many schools report that the music made by record companies to sell is what teenagers listen to the most and that it has come to mean noise for many educators (Brescia, 2011).

The responses of each individual to the musical sounds heard will depend on the memory and tonal organization that this person makes of the sound, the duration of the notes and phrases, the sound intensity, the timbre used, the melody built, the harmony and the rhythmic organization built over time (Brescia, 2011). “A musical experience guided by conscientious professionals, favors sensitivity, creativity, rhythmic sense, a more refined musical ear” (Brescia, 2011, p.14).

However, the problem can be directed to a discussion focusing on aspects involving the quality of music education and musical development throughout life. In this sense, proposing to reduce the inequality of musical knowledge between different individuals can point to different ways of acquiring musical knowledge and how much this can impact the quality of their production and performance. To assess this performance of the musical perception of Brazilians, we sought to apply a test with proven effectiveness to this population, the MET (Music Ear Test).

The MET (Music Ear Test) was developed in Denmark (Wallentin, et al., 2010b), designed to objectively measure musical perceptual skills in musicians and non-musicians for a relatively short duration. The same study showed that the MET clearly distinguishes musical skills between groups, such as professional musicians, amateur musicians, and non-musicians. The test also showed a strong correlation with measures of musical experience obtained by another test. Wallentin et al. (2010a) described that they offered good internal consistency (Cronbach, 1951) for the test as a whole (0.85); for the melodic part, it was 0.82; and for the rhythmic component, it was 0.69. The test was replicated (Hansen, et al., 2013) and confirmed the MET's ability to distinguish between musicians and non-musicians but did not confirm its ability to differentiate between amateurs and professionals.

According to Swanwick (2001), even if abstractly, musical expression is connected to the perception of musical character through tonal or atonal phrases, rhythms, timbres, accents, speed, and sound intensity levels. A music educator, who teaches with the value of musical experience in mind, is likely to have students who, when playing or singing, will be more satisfied with their musical understanding results. Musical notation and melody structures are ways of visualizing a specific section of the individual's experience with music through an analytical approach in a restricted way. But still, according to this author, there is a way to deal with music more intuitively but analytically and effectively, an auditory analysis, where the sounds become expressive, known, and familiar forms, giving new meaning to the melodic line. “In music education, for learning an instrument, singing, learning to hear and reproduce musical notes and their different pitches are the first steps towards understanding music” (Chinaglia, 2022 p.2).

The MET has already been applied in other countries, such as Chinese with congenital blindness (Chen, et al., 2019) who speak Mandarin. The results in that country indicate that tonal language experience and congenital blindness exert

differential influences on musical skills, with the perception of rhythm reflecting a compensation effect and melody perception dominated by a language containing different vocal intonations, these sounds being replicated in music. The test was also applied in Canada (Swaminathan & Schellenberg, 2018), where they used two groups of people, native and non-native English speakers. Among non-native speakers, there were representatives of tonal and atonal languages, and speakers of tonal languages performed better in the melody subtest but not in the rhythm subtest. They also conclude that the MET is an adequate test to measure musical abilities objectively.

Wallentin et al. (2010b) indicates that there may be a difference in age and length of study in more diverse groups since the sample used in his research was homogeneous. The MET can distinguish a group of non-musicians from a group of amateur musicians and amateur musicians from a group of professional musicians. This author suggests that the MET can be used to check musical working memory, comparing the results with other short-term memory listening tests.

Being able to test the musical perception of Brazilians with a perception test already used in other countries and comparing the data obtained will be a way to characterize this population, and who knows how to identify how Brazilians perceive different or the same sounds through music education in Brazil. So far, there is no knowledge of using this assessment instrument in this format presented by Wallentin et al. (2010b) in Brazil.

The objective of the present study was to verify if, in the Brazilian population, with a more heterogeneous sample concerning age and musical training, the MET test can differentiate the musical perception between professional musicians, amateur musicians, and non-musicians.

2. Methodology

This is a research, with the methodology of a quantitative approach of the comparative type and a cross-sectional design (Creswell, 2014; Sampieri, 2014).

Participants

A sample of 63 participants was used, divided into three groups of 21 participants in the categories: non-musicians, amateur musicians, and professional musicians. For this study, we used the definitions for each category described by Wallentin et al. (2010b). Non-musicians were defined as people who never played any musical instruments, as well as people who started to study an instrument but stopped and did not play any musical instrument in the last two years. Amateur musicians were defined as musicians who had been playing an instrument for at least two years and practiced their instrument for at least an hour per week at the time of the current study. Professional musicians were defined as participants who either made a living by playing music and/or were enrolled in or educated from one of the musical academies offered in the country.

The following information was collected: age, sex, education, if study music, if play a musical instrument, how long have studied music, and how many hours per week practice the instrument. The project was approved by the Research Ethics Committee of State University of Paraná (UNESPAR) under number: 083170/2021.

Measurements

The tests were carried out individually or collectively, observing the safety criteria established by the World Health Organization, considering that the collections were made during the Covid-19 pandemic, such as using masks and gel alcohol. The distance between people was maintained and carried out in a ventilated place.

The musical perception was assessed by the Musical Ear Test (Wallentin, et al., 2010b). Participants received verbal instructions on how the test works. They also received material (pen, clipboard) and the form to fill in the test answers. With the participants, an individual earphone connected to an MP3 player was used with the recording of the melodic and rhythmic

tests. Only the original instructions were recorded in Portuguese and placed at the beginning of each test, maintaining the test's fidelity. All tests were carried out in person.

The test consists of 104 sounds in which the participants, when listening to each one, judge whether the musical phrases heard are the same or different, marking what they perceived on the form sheet in the corresponding place.

In this test, two fundamental aspects of music are evaluated separately: melody (including tone and melodic contour) and rhythm. The melodic part contains 52 pairs of melodic phrases played with piano sounds, and the rhythm part comprises 52 pairs of rhythmic phrases played with a wooden sound block and a drumstick (Wallentin, et al., 2010b).

Statistical Analysis

Statistical analysis were done in R (R Core Team, 2021). Normality tests were performed using the Kolmogorov Smirnov test with Lilliefors correction (nortest package). The equality of variances between the groups was verified with the Bartlett test. Analysis of variance (ANOVA) was performed with the test scores (melodic, rhythmic, and total) and the groups (MP, MA, and NM). Duncan's test was used as a post hoc (agricolae package). The correlation was done with PerformanceAnalytics (package).

3. Results

Demographic data and results obtained with the MET are shown in Tables 1, 2 and 3. No gender difference was found between the groups ($p = 0.86$). As for age, professional musicians are significantly older than amateur musicians ($p = 0.02$). Regarding education, there was only a significant difference between professional musicians and non-musicians ($p = 0.04$).

Table 1. Demographics and results from non-musicians group (n = 21, 11 female).

	M	SD	Mdn	Min	Max
Age (years)	39.67	14.99	38.00	21	76
Education (years)	13.79	2.52	15.00	8	18
Weekly practice (hours)	0.10	0.30	0.00	0	1
Instrument experience (years)	0.74	1.45	0.00	0	6
MET - melody	34.19 (65.75%)	5.11	34.00	26	42
MET - rhythm	34.14 (65.65%)	4.86	35.00	22	40
MET - total	68.33 (65.70%)	9.46	70.00	49	82

Note: M: mean, SD: standard deviation, Mdn: median; Min: minimum; Max: maximum.
Source: Authors.

As we can see in Table 1, the group of non-musicians got around 65% right on the MET, both in the general score and in the sub-tests.

Table 2. Demographics and results from amateur musicians group (n = 21, 11 female).

	M	SD	Mdn	Min	Max
Age (years)	33.57	14.80	28.00	18	70
Education (years)	14.52	2.27	15.00	11	22
Weekly practice (hours)	6.33	5.59	4.00	1	21
Instrument experience (years)	14.88	10.01	12.00	2	46
MET - melody	36.00 (69.23%)	5.12	37.00	27	44
MET - rhythm	36.48 (70.15%)	4.29	37.00	28	44
MET - total	72.48 (69.69%)	7.90	73.00	58	88

Note: M: mean, SD: standard deviation, Mdn: median; Min: minimum; Max: maximum. Source: Authors.

The group of amateur musicians managed to hit about 70% of the MET, a higher percentage, but not significant, than the group of non-musician (Table 1 and 2).

Table 3. Demographics and results from professional musicians group (n = 21, 9 female).

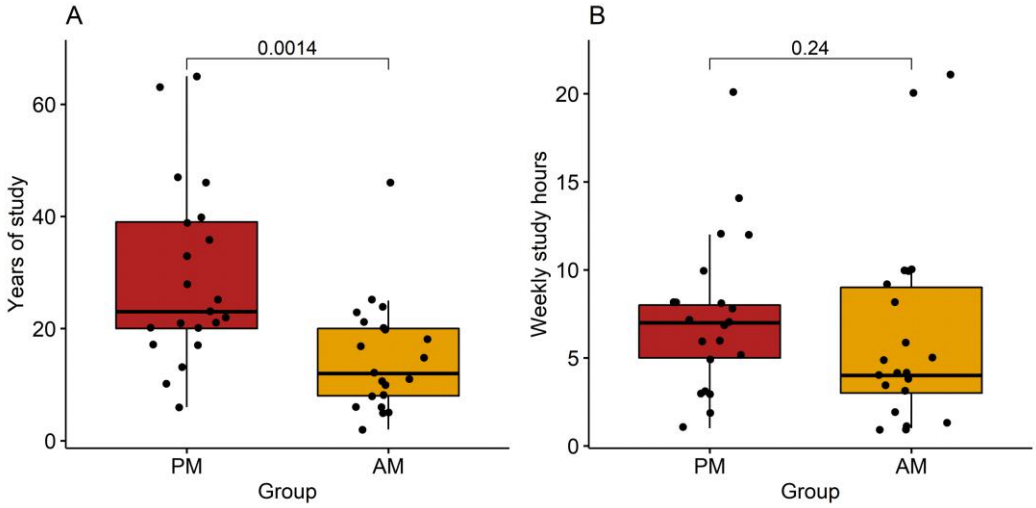
	M	SD	Mdn	Min	Max
Age (years)	42.57	14.52	39.00	21	72
Education (years)	15.43	1.66	15.00	13	20
Weekly practice (hours)	7.38	4.46	7.00	1	20
Instrument experience (years)	29.14	16.09	23.00	6	65
MET - melody	43.43 (83.52%)	4.85	44.00	30	51
MET- rhythm	42.00 (80.77%)	2.76	42.00	37	46
MET - total	85.43 (82.14%)	5.55	86.00	72	96

Note: M: mean, SD: standard deviation, Mdn: median; Min: minimum; Max: maximum. Source: Authors.

In the professional musicians group, the better score was obtained in the melody sub-test, and all scores were higher than in the other groups

Professional musicians have been playing for longer than the surveyed amateur musicians (Figure 1A), but there is no difference between weekly instrument study time (Figure 1B) when compared between groups.

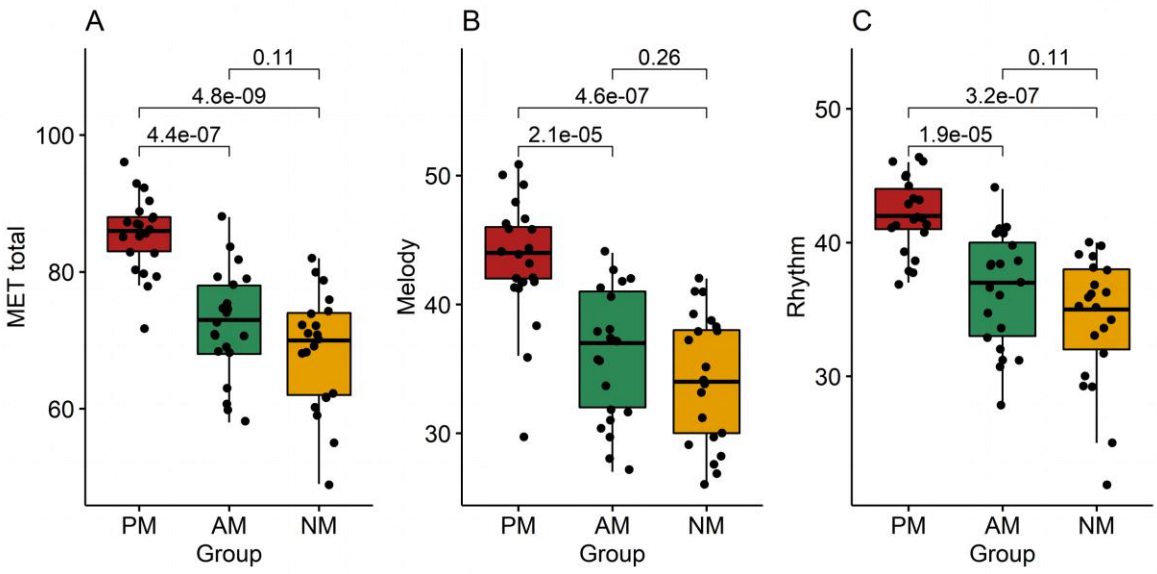
Figure 1. Comparison of study time and weekly music study hours between professional musicians (PM) and amateur musicians (AM).



Source: Authors.

Regarding the score on the MET test, the test was able to separate professional musicians from amateur musicians and non-musicians. Still, it did not discriminate between amateur musicians and non-musicians, considering the total score (Figure 2A), the melodic score (Figure 2B), and rhythmic (Figure 2C).

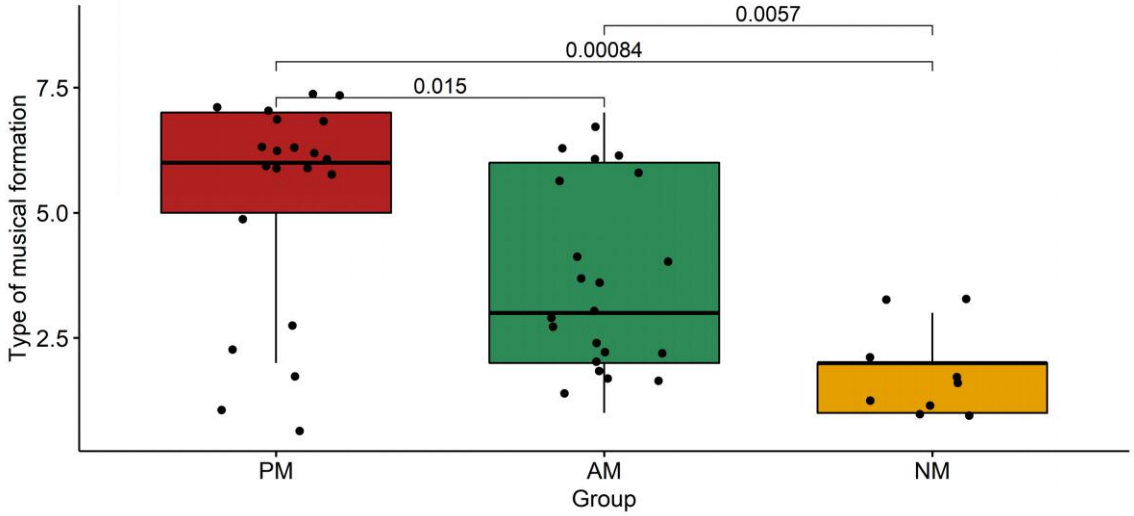
Figure 2. Comparisons of MET scores (total, melody, and rhythm) between groups.



PM: professional musicians, AM: amateur musicians, NM: non-musicians. Source: Authors.

The Figure 3 shows the heterogeneity of the music education of amateur musicians. This variable show whether the participants still study or studied at a music school and/or with a private teacher and/or alone.

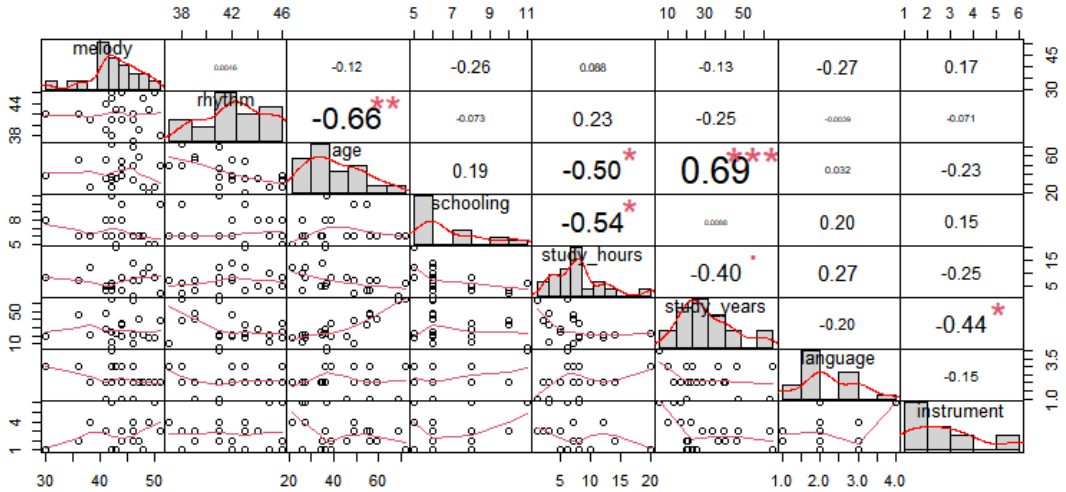
Figure 3. Types of music education among groups. Types are a music school, private teacher, by oneself or its combinations.



PM: professional musicians, AM: amateur musicians, NM: non-musicians. Source: Authors.

In the group of professional musicians, we can see that the score on the rhythmic subtest is negatively correlated with age (Figure 4). We can also see that weekly studies in hours are negatively correlated with age. The variable time studied shows a positive correlation with age and a negative correlation with the number of instruments played.

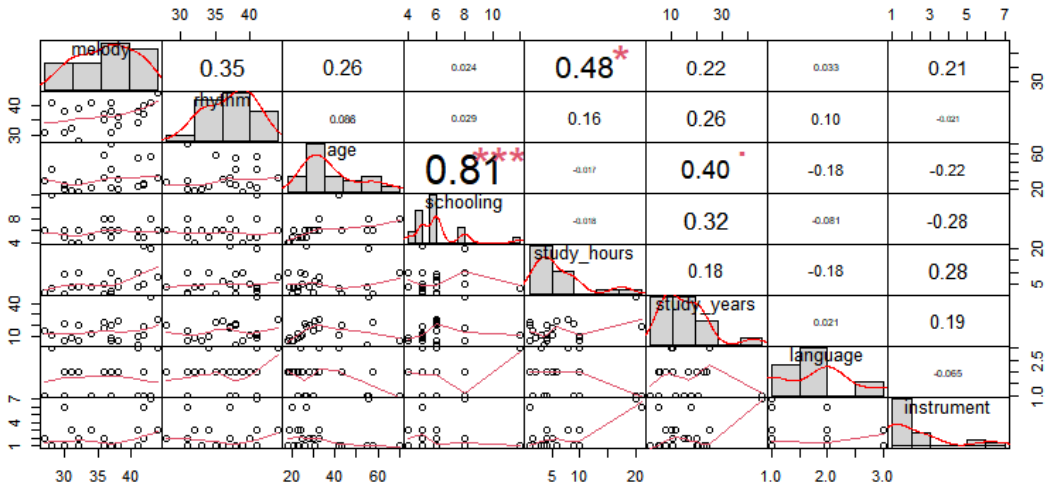
Figure 4. Correlation between MET scores (melody and rhythm) and other variables in professional musicians.



Note. Melody = score in melody subtest; rhythm = score in rhythm subtest; age = participant age; schooling = schooling in years; study_hours = weekly hours of music study; study_years = years of music study; language = number of languages understood; instrument = number of instruments played. Source: Authors.

In the group of amateur musicians, we can see a positive correlation between hours of the weekly study and the score of the melodic sub-test (Figure 5). We can also verify that the level of education is positively correlated with age in this group.

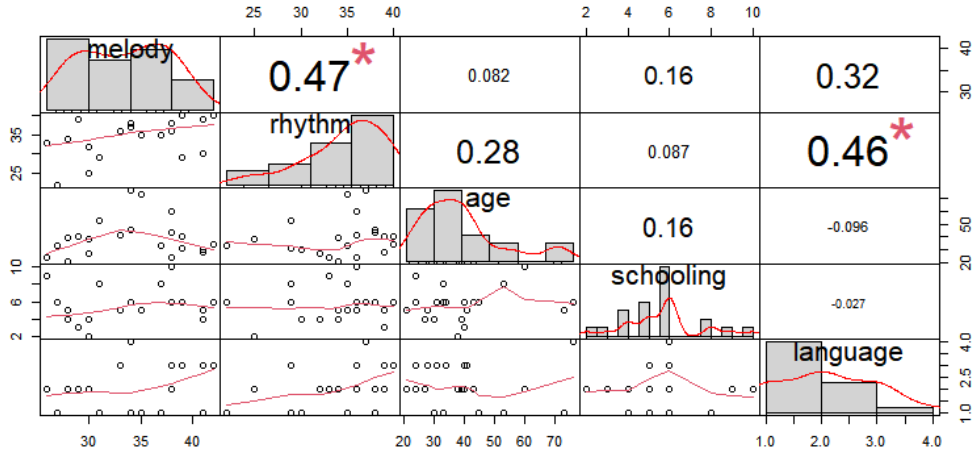
Figure 5. Correlation between MET scores and other variables in amateur musicians.



Note. Melody = score in melody subtest; rhythm = score in rhythm subtest; age = participant age; schooling = schooling in years; study hours = weekly hours of music study; study years = years of music study; language = number of languages understood; instrument = number of instruments played. Source: Authors.

The group of non-musicians was unique in that the score on the melodic subtest was positively correlated with the score on the rhythmic subtest (Figure 6), and the number of languages was positively correlated with the score on the rhythmic subtest.

Figure 6. Correlation between MET scores and other variables in non-musicians.



Note. Melody = score in melody subtest; rhythm = score in rhythm subtest; age = participant age; schooling = schooling in years; language = number of languages understood. Source: Authors.

4. Discussion

The MET efficiently separated the group of professional musicians from the other groups. However, the Brazilian sample could not separate the group of amateur musicians from non-musicians. This result may be because the group of Brazilian amateur musicians is quite heterogeneous in its formation, different from countries where the test has been applied previously.

Music has been introduced and withdrawn from the curriculum of primary and secondary schools in Brazil (Penna,

2008). In the 90s, music became a mandatory part of the Brazilian school curriculum again, but within a discipline of artistic education (Penna, 2008), which makes it difficult for children and adolescents to learn music, often due to the excess number of students or the lack of resources, ranking last in terms of spending and investments by several Brazilian families (Molina, 2013). The vast majority of private music schools are paid, and there is no uniformity regarding the methodology applied. There are few free music schools in the country at a technical level with a well-structured method and an effective curriculum, such as Dr. Carlos Campos, in Tatuí, São Paulo. At the undergraduate level, there are courses offered at state and federal universities with excellent professionals maintained by governments.

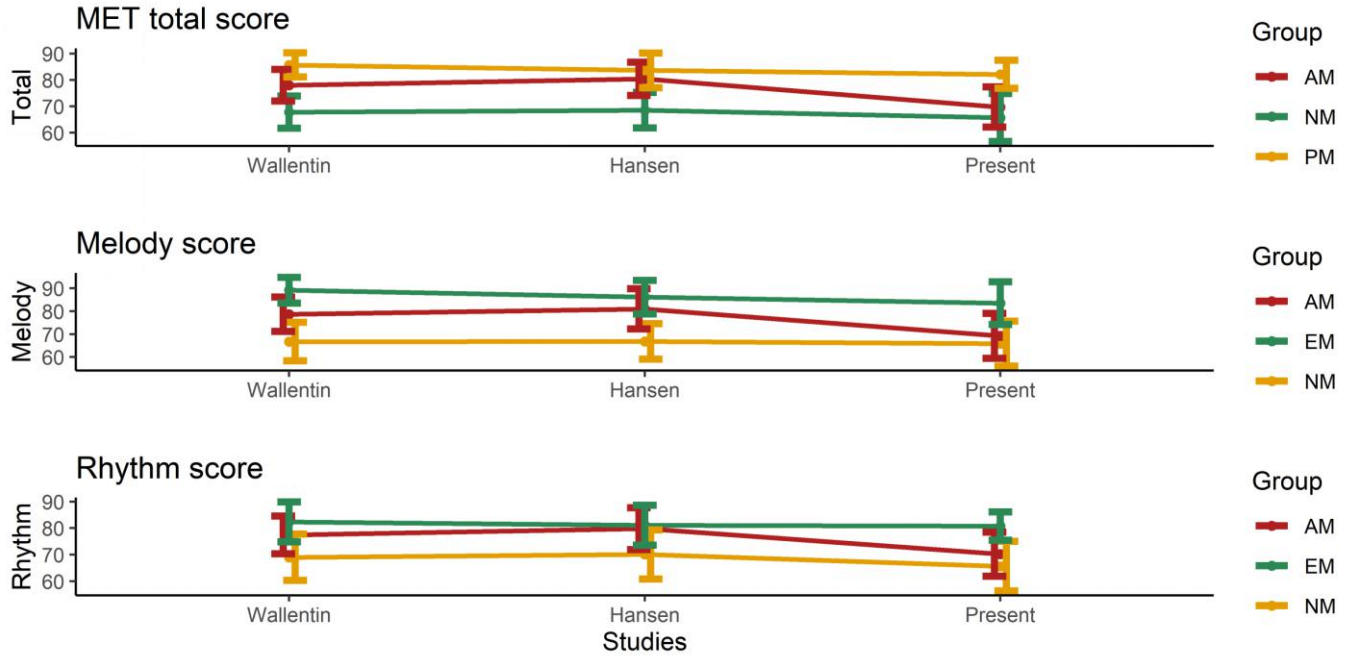
For this reason, music education in Brazil can vary greatly, depending on the time of music study, which music school you studied, what musical references you had, and how long you have been playing the instrument. This heterogeneity can be seen in the group of amateur musicians (Figure 3). The development of musical perception tends to start very early, in the first years of life. But continuing to develop it will depend on continuous stimuli from the age of 9 for the development of musical skills (Brescia, 2011). Through the present study carried out with the MET we can see in terms of teaching and learning, musical development still takes place in small steps, given the lack of scientific dissemination of teaching and learning based on the experience of those who learn, as those who learn and how they learn.

Linking childhood musical experiences with later stages of musical development and engagement in adulthood remains a challenge for epidemiological studies. According to Bonde et al. (2018) in all, a third of respondents reported that they sang or played musical instruments in their childhood home, had already sung or played as a professional musician at some point in their lives. All this information directly influences the individual definitions that amateur musicians and professional musicians have of melodic line, scales, whether tonal, atonal, major and minor, as well as the rhythmic identification of syncopations, triplets, and setbacks, which is probably why the test was not able to separate this group from the others.

In the oral tradition of urban popular music, according to Molina (2013), outside music schools, musical learning takes place in contact with the whole. Voice and rhythm, vocal and instrumental skills come through direct participation in community music (local parties, social parties) or regular practice of an instrument or group singing. This same author also reports that despite disorganized teaching, musicians tend to develop their musicality.

The study by Wallentin et al. (2010b) managed to separate the three groups with the MET with a Danish population. However, in the replication of the study, in Denmark, the MET did not separate professional musicians from amateurs (Figure 7).

Figure 7. Comparison of MET results with Wallentin et al. (2010b) and Hansen et al. (2013).



EM: professional musicians, AM: amateur musicians, NM: non-musicians. Source: Authors.

Schools in Denmark can be state-run by the Danish Ministry of Culture. The Royal Academy of Music (2022) department in the heart of Aarhus is one of them, with a standardized quality methodology and high-quality modern facilities. In this music academy where the study was carried out in Denmark, there is an adequate structure for teaching with a wide variety of rooms used for teaching interaction groups and choir, in addition to 100 teaching and practice rooms of different sizes that are the place for daily work of teachers and students, which is not the Brazilian reality. Only a few music undergraduate courses in Brazilian universities have rooms equipped with relevant collections of instruments and a considerable collection of instruments in good condition that can be loaned to students to practice. The Royal Academy of Music to which the MET was first applied is a traditional institution that for over 80 years has trained exceptional musicians and music teachers and is constantly evolving in new directions and exploring new areas of study.

The Academy or music school which musicians should emphasize 'full musicality' and an entrepreneurial mindset, giving students an understanding that contemporary life as a professional musician often encompasses many different aspects and areas of work and learns to deal with and relate to artistic outreach activities, musical pedagogical and different workspaces. You must be able to lead interdisciplinary interactions and collaborations as a musician, communicator, and interlocutor of your own story.

Analyzing the MET results in the Brazilian population, which has a diversified musical background and resources not always available, we observed, with the other variables analyzed, that rhythmic perception is inversely correlated with age for professional musicians. The study of rhythm throughout musical learning is almost always restricted to knowing how to measure the duration of sounds, which is fundamental in a good performance of a musical work. Still, the continued dependence on counting the time of the symbols used causes the problem of lack of attention in the rhythmic expression, modifying the individual's rhythmic perception (Gramani, 2008). Without the developed rhythmic perception, the musician ceases to be creative and becomes imitative. Imitating the proposed rhythm has importance in terms of academic and learning levels. However, there is a need to seek new knowledge, creating new possibilities of rhythmic structure, increasing the mental storage of rhythmic structures, and leading the individual to perceive and differentiate simple and complex structures.

Learning musical intervals involves discriminating between various categories or types of intervals. They can be defined by a fixed frequency distance between two notes or sounds that can be one in sequence (melodic) or simultaneously (harmonic) (Wong, et al., 2021). It is not an easy task, as it is necessary to discriminate the sounds, which in trained musicians happens more quickly due to the repetition of many melodic and/or harmonic intervals in a daily study in the practice of the instrument. As for non-musicians, as they do not have an apparent reference to these intervals due to the practice of a musical instrument, they end up identifying more easily unknown intervals. These intervals do not mention any previously known musical melody. The same author reports that there are studies on interval teaching with a diversity of sounds interspersing them, making neuronal processing more active than when compared teaching intervals by repetition (Wong, et al., 2021).

This variation may be related to perception, cognition in general and working memory. Music learning also takes place in this domain, among others. Auditory processing is the ability to accurately represent and remember characteristics of sounds, such as rhythm, that are also present in the speech process through temporal processing. Just as in speech, musical rhythm has shorter and longer sounds, phonation time, and pauses between words; in prosody, we can identify strong sounds from weak sounds (Saito, et al., 2021). This process is most likely why in the group of non-musicians studied here, there is a significant correlation between the rhythmic subtest for a group of more than one spoken language.

Since 1919, "Musical Talent Measures" have emerged that assess aspects of musical ability. Also according to Brescia (2011) several instruments to measure from musical ability, musicality, rhythmic abilities, listening skills, musical performance were created between 1972 and 1982. But according to this same author in Brazil it is still something limited and very little researched.

According to Zentner and Strauss (2017) to assess musical skills, it is necessary to use tests aimed at musical skills. These tests generally can also grade musical knowledge in non-musicians by measuring pitch recognition and timing ability. Tests such as the MET can also help to map existing gaps in the training of professional and amateur musicians so that they can seek more knowledge in sub-areas in which they did not perform well.

When applying the MET in the Brazilian population, we noticed that it has good internal consistency and very good reliability to be applied also in test-retest, as well as the Goldsmiths Musical Sophistication Index (Gold-MSI), tested and adapted for use with Portuguese-speaking individuals (Lima, et al., 2020). According to this same author, musical sophistication refers to skills, achievements and experience related to music. Active involvement with music in its multiple forms, coupled with a repertoire practiced daily, would lead to a greater variety of musical patterns.

For Lima and Correa (2018), musical abilities vary when compared between individuals from different cultural groups, as people can be involved in different ways with music, which leads to research and scoring the individual difference of each group of musicians (Bourdieu, 2007). Some music schools have sought to adapt their structure, content and pedagogical approaches in music teaching, often balancing institutional prestige with the demands of the job market and the needs of students and teachers (López-Íñiguez & Bennet, 2019).

Musicians need to maintain many capabilities beyond performance to sustain a career. However, it involves a complex web of motivation, time, education systems, vocational concerns and perceptions of success (López-Íñiguez & Bennett, 2019).

5. Conclusion

The MET managed to separate professional musicians from other groups, but with a heterogeneous group of amateur musicians, it was impossible to distinguish them from non-musicians. We can also verify that age influences the rhythmic perception in professional musicians and that the weekly hours of musical study influence the melodic perception. Comparing our results with those made by Wallentin et al. (2010b), the Brazilian population has a similar score even with all the

difficulties, which indicates that this perception test can be replicated for any individual within the population.

A future perspective would be to categorize the group of amateur musicians according to the level of experience or study. This would make this group less heterogeneous.

Acknowledgments

We thank Peter Vuust for sharing the Music Ear Test.

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