Original Article

A Musical Perception Test for People with Hearing Loss: Turkish Adaptation and Normalization of the Music Perception Test (MPT)

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Abstract

Objectives: The aim of this study was to develop a Turkish musical perception test that provide the opportunity to measure music performance of people with hearing loss. **Subjects and Methods:** In the study, the Music Perception Test (MPT), which was translated and adapted into Turkish, was applied randomly to 100 individuals aged between 18–40 years. The test was applied with computers and professional head phones to 20 individuals chosen as a pilot study. Data obtained after the pilot study were evaluated and the application to the other 80 participants were completed. In order to obtain validity and credibility data, 20 randomly chosen participants were retested. **Results:** The average total score of the MPT of the participants was 97.5 ± 12.2 (Min: 69, Max: 120). As the total score of the MPT has been examined, low value for ± 1SD was 85.3/top value was 109.7; low value for ± 2SS was 73.1/top value was 121.9; low value for ± 3SS was 60.9/top value was 134.1. In our study, the value of internal consistency of the Turkish MPT was 0.898. This value indicates that the test was reliable. In a similar manner, considering the correlation of test-retest parameters, both subtests and total score results showed the results were reliable. With the examination of the results there were no relation between the total scores of the MPT and age (r:0.176, p: 0.080) but the interest in music (r: 0.641, $P < 0.001$) and the frequency of listening to music (r:0.479, $P < 0.001$) had an important effect on the total scores of musical perception. The difference in the total scores of the MPT between female and male participants were found to be statistically significant ($p < 0.001$). **Conclusions:** Results of this study show that the Turkish MPT is a valid and reliable musical perception test for the Turkish people who have normal hearing and hearing loss.

Keywords: *Adaptation, hearing loss, MPT (Music Perception Test), music, normalization, Turkish*

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Introduction

Music is one of the most important factors that has a positive effect on the quality of life among people who can hear normally and among those with hearing loss as well.[1] Research shows that musical perception and musical taste of people with hearing loss and those using amplification technologies (hearing aids, cochlear implants) are affected negatively.[2-5] Though amplification technologies have made progress on hearing and speech perception, studies on musical perception are ongoing. It is important to evaluate the musical perception skills of people with hearing loss in order to determine the musical performances. This evaluation should be performed using extensive tests that make it possible to achieve objective results.[6] When the musical perception skills of an individual are assessed using tests that evaluate different components

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of music (rhythm, intonation, instrument voice, melody, etc.), the results will be more realistic and detailed. Today, hearing aid technologies still cannot reach the required level of musical perception skills, and musical perception and musical taste still play a role in the problems of patients who have hearing loss. Therefore, these problems form the basis of this study. Musical perception and taste can also be affected by hearing aids. The basic principle of the hearing aid is to amplify voices. The hearing aid circuit can be adjusted to help the user hear to speech sounds better. Hearing aids cannot always make musical voices sound natural, but when compared with cochlear implants that transmit only a specific part of total sound waves, they produce a more natural musical signal.[7] After numerous scientific studies have proved the positive effects of cochlear implants upon speech perception, studies on music perception have gained momentum lately. Furthermore, in other related studies, adult cochlear implant users perform considerably worse in basic music tests than individuals who can hear normally and ones using hearing aids.[7-10] First of all, cochlear implants (CI) are developed for individuals to gain speech perception. For that reason, CI users are very successful in recognition, differentiation, and perception of speech, but users can show difficulty in music listening, musical taste, and musical perception skills. Users who can easily perceive basic rhythms have difficulty in following melodies.[11,12] Studies show that users' listening periods decreased after the implant compared with before, as they avoided listening to music because of the irritating sound they hear. They often define music as "mechanical, loud, unnatural, and elusive voices".[13]

During the studies, it was determined that CI users show similar performance on rhythm recognition and differentiation tests to individuals who can hear normally.[10,14-18] CI users do not perform as well in pitch tests as in rhythm tests, and they get lower scores. CI users have lower pitch recognition skills than individuals who can hear normally and those using hearing aids.[19] This is the most important factor that affects the musical perception of CI users negatively. In this study, we aimed to develop a musical perception test that provides an opportunity to measure musical performance of both people who can hear normally and ones using hearing aids or cochlear implants. Unfortunately, there is no available and reliable musical perception test in our country that can evaluate musical perception skills for people who can hear normally and who have hearing loss. The aim of this study therefore was to adapt the Music Perception Test (MPT), which is widely used in international scientific studies, and introduce a test into our country that evaluates musical perception objectively.

Materials and Methods

The study was approved on 09.03.2016 at the 2016/03 numbered meeting of the Clinical Research Ethics Committee by the decision numbered 99950669/56.

a. Participants

100 individuals between the ages of 18 and 40 years who had normal hearing and no professional music education were involved in the study. 50 of them were male, and 50 were female. The average age of the participants was 25.3 ± 6.9 years. During the study, both individuals' age criteria and gender balance were important. Apart from these two factors, participants were selected randomly regardless of education, profession, or socioeconomic status. Before the test was applied, all participants signed the "Informed Consent Form", in which information about the content of the study was given. A "Volunteer Approval Form" was given too.

b. Data tools

Participant information form

This data-gathering form contains 18 open- and closed-ended questions that examined the participants' interests and experiences about music with socio-demographic information. Questions 1-13 asked about age, gender, education, profession, marital status, socio-economic status, health insurance, disease/disability, and medication status. Questions 14-18 gathered information about participants' professional music education status, period and genre of any music education received, instrument-playing status, level of interest in music, frequency of listening to music, and music genre information.

Music Perception Test (MPT)

The MPT is a musical perception evaluation test developed by Uys and Van Dijk[20] and consists of 4 sections and 11 subtests.

Section A-Rhythm

Test 1: Rhythm identification
Test 2: Rhythm discrimination
Test 3: Rhythm recognition
Test 4: Sensing rhythm.

Section B-Timbre

Test 5a: Timbre identification - single instruments
Test 5b: Timbre identification - multiple instruments
Test 6: Identification of number of instruments.

Section C-Pitch

Test 7: Pitch identification
Test 8: Pitch discrimination.

Section D-Melody

Test 9: Musicality
Test 10: Melody identification
Test 11: Melody in noise.

The MPT includes a test CD that contains subtest contents and 14 audio files consisting of introduction to conclusion speeches and a Musical Perception Evaluation Answer Sheet. The application period for the original test is approximately 57.17 minutes. After the test is brought to our country, translations were made of the audio CD and Musical Perception Evaluation Answer Sheet. It was determined which items were improper for our country's structure, features, culture, and adaptations were made to these items.

c. Application

Individuals ages 18-40 years who can hear normally and are not professional musicians, and do not have music education were included in the test. All participants were given a "Participant Information Form" before the MPT. After the participant information form was filled out, the MPT was applied in a quiet room with computers and professional headphones to 20 individuals chosen on a pilot basis. Before the test was applied, the content of the test was explained verbally, and the participants were informed about completing the given form. The Turkish version of the test consists of 14 audio files, and the time it takes to complete the test is approximately 53.83 minutes. Data obtained after the pilot study were evaluated, and the application to 80 other participants were completed. In order to obtain valid and credible data, 20 randomly chosen participants were retested. Scoring for the MPT, which contains 11 subtests and four basic fields, can be calculated as the musical perception total score. The highest score in the MPT is 140. In addition, all of the four basic fields (rhythm, timbre, pitch, and melody) can be scored in themselves, or scoring can be made for every single subtest.

Statistical analysis

Data gathered from individuals were analyzed with IBM SPSS (Statistical Package for Social Sciences) version for Windows Version 22.0 (IBM Corp.; Armonk, NY, USA). Numeric variables were summarized with average standard deviation. The normal distribution of categorical variables was examined using the Kolmogorov-Smirnow test, and homogeneity of variances was examined using the Levene test. In terms of numeric variables, differences between the two independent groups were examined using a t-test in case of provision of parametric test variances. In comparing more than two independent groups, one-way variance analysis was used in case of provision of parametric test variances. The relation between the numeric variables was researched using Pearson correlation coefficient. Internal consistency of total and sub-dimensions of the scale is shown with Cronbach's alpha coefficient. Test-retest correlation is given with intra-class correlation coefficient (ICC). Significance level is assumed as $P < 0.05$.

Results

Most of the participants (N: 75) had college and higher education degrees (secondary school N: 5, high school N: 20), and 60% of the participants (N: 60) were students (self-employment N: 20, officer N: 19, worker N: 1). The participants scored their interest level in music and their frequency of listening to music between 1 and 10. The average interest level in music was 6.7 ± 2.7, and the frequency of listening to music was 7.5 ± 2.3. Table 1 shows the distribution of the music

Table 1: The distribution of the music type of the participants

Music Type	*n*	Percentage
Classical Music	7	7,0
Pop Music	21	21,0
Turkish Classical Music	13	13,0
Turkish Folk Music	17	17,0
Foreign music	12	12,0
Arabesque Music	10	10,0
More than one music type	20	20,0
Total	100	100,0

N: Number, %: Percent

Table 2: The distribution of the averages of MPT and Subtest scores of the participants

Subtests of MPT		
Section A-Rhythm	**Mean±SD**	**Min - Max**
Rhythm identification	9,2±1,2	5 - 10
Rhythm discrimination	7,9±1,7	4 - 10
Rhythm recognition	8,1±1,5	4 - 10
Sensing rhythm	7,5±2,0	3 - 10
Section B- Timbre	**Mean±SD**	**Min - Max**
Timbre identification -Single instruments	8,8±2,7	5 - 13
Timbre identification -Multiple instruments	4,5±2,3	0 - 8
Identification of number of instruments	4,2±1,3	2 - 7
Section C- Pitch	**Mean±SD**	**Min - Max**
Pitch identification	7,4±1,6	5 - 10
Pitch discrimination	6,6±1,5	4 - 10
Section D-Melody	**Mean±SD**	**Min - Max**
Musicality	5,2±1,4	2 - 8
Melody identification	18,1±2,4	10 - 20
Melody in noise	8,9±1,1	6 - 10
MPT Total Score	97,5±12,2	69 - 120

SD: Standard Deviation, Min: Minimum, Max: Maximum

Table 3: The limits of normality and the value of standard deviation according to MPT and Subtests

Subtests of MPT	±1SD		±2SD		±3SD	
	L	U	L	U	L	U
Rhythm identification	8	10,4	6,8	11,6	5,6	12,8
Rhythm discrimination	6,2	9,6	4,5	11,3	2,8	13
Rhythm recognition	6,6	9,6	5,1	11,1	3,6	12,6
Sensing rhythm	5,5	9,5	3,5	11,5	1,5	13,5
Timbre identification-single instruments	6,1	11,5	3,4	14,2	0,7	16,9
Timbre identification-multiple instruments	2,2	6,8	-0,1	9,1	-2,4	11,4
Identification of number of instruments	2,9	5,5	1,6	6,8	0,3	8,1
Pitch identification	5,8	9	4,2	10,6	2,6	12,2
Pitch discrimination	5,1	8,1	3,6	9,6	2,1	11,1
Musicality	3,8	6,6	2,4	8	1	9,4
Melody identification	15,7	20,5	13,3	22,9	10,9	25,3
Melody in noise	7,8	10	6,7	11,1	5,6	12,2
MPT Total Score	85,3	109,7	73,1	121,9	60,9	134,1

SD: Standard Deviation, L: Lower Value, U: Upper Value

Table 4: The limits of normality and the value of standard deviation according to the averages of familiar instrument and the number of melody in MPT

Subtests of MPT	±1SD		±2SD		±3SD	
	L	U	L	U	L	U
Timbre identification Single instruments	4,4	7,6	2,8	9,2	1,2	10,8
Melody identification	8,1	10,1	7,1	11,1	6,1	12,1
Melody in noise	15,2	19,6	13	21,8	10,8	24

SD: Standard Deviation, L: Lower Value, U: Upper Value

Table 5: The relation between the variables of the total score of MPT and gender, educational level and music type

		Mean±SD	*p*
Gender	Female	92,8±11,8	**<0,001**
	Male	102,3±10,8	
Educational Level	Secondary School	87,2±17,4	**0,004**
	High School	89,3±9,3	
	Collage and higher education	100,4±11,3	
Music Type	Classical Music	83,7±1,6	**<0,001**
	Pop Music	81,9±13,7	
	Turkish Classical Music	108,7±0,8	
	Turkish Folk Music	94,0±8,3	
	Foreign music	107,6±1,1	
	Arabesque Music	72,4±3,6	
	More than one music type	104,5±9,5	

SD: Standard Deviation

type of the participants. 21% of the participants listened to pop music; 17% of the participants were keen on Turkish folk music; and 13% of them listened to Turkish classical music. While 20% of the participants listened to more than one music type, the rate of Arabesque listeners was 10%.

a. The Analyses of Total Score And Subtest Score of MPT

Table 2 shows the distribution of the averages of the MPT and subtest scores of the participants. When the scores of the participants in the field of rhythm were examined, it can be seen that the participants scored highest on the "rhythm identification" subtest (9.2 ± 1.2), followed by the "rhythm recognition" (8.1 ± 1.5) and "rhythm discrimination" subtests (7.9 ± 1.7). Within the field of rhythm, the participants scored lowest in the "sensing rhythm" subtest (7.5 ± 2.0). While the participants scored highest (8.8 ± 2.7) in "timbre identification - single instruments," they scored quite low in the "timbre identification - multiple instruments" (4.5 ± 2.3) subtest in the field of timbre. The participants performed worst in the "identification of number of instruments" (4.2 ± 1.3) subtest within the MPT. Within the field of pitch, the participants scored higher in the "pitch identification" subtest (7.4 ± 1.6) than in the "pitch discrimination" subtest (6.6 ± 1.5). Despite underachieving in the "musicality" subtest (5.2 ± 1.4), the participants were more successful at the "melody identification" subtest (18.1 ± 2.4) and the "melody in noise" subtest (8.9 ± 1.1) within the field of melody. Participants' average total score on the MPT was 97.5 ± 12.2 (Min.: 69, Max.: 120). The maximum total score for the test is 140.

The participants were asked whether they recognized the sounds of 8 instruments before the subtest on "timbre identification - single instruments" within the timbre field. It can be seen that the participants recognized 6.0 ± 1.6 instruments on average (Min.: 3, Max.: 8). In the "timbre identification - multiple instruments" subtest, 8 instruments (as 2 or 3 instruments) are played to the participants (37 instruments voices). In this field, the participants averaged 21.0 ± 4.5 (Min.: 8, Max.: 28). In the field of melody, the participants stated that they recognized 9.1 ± 1.0 out of 10 instruments in the "melody identification" subtest, and 17.4 ± 2.2 out of 20 instruments in the "melody in noise" subtest.

The MPT and subtest results showed internal consistency and correlation between test and retest. When the results were examined, the value of internal consistency of the MPT was 0.898; this value indicates that the test is reliable. In a similar manner, considering the correlation of test-retest parameters, both subtests and total score results showed the results were reliable. In Table 3, the limits of normality and the value of standard deviation are given according to the MPT and subtests. As the

total scores of the MPT have been examined, the low value for ± 1SS is 85.3, and the top value is 109.7; the low value for ± 2SS is 73.1, and the top value is 121.9; the low value for ± 3SS is 60.9, and the top value is 134.1.

In Table 4, the limits of normality and the value of standard deviation are shown according to the averages of familiar instruments and the number of melodies in the MPT. In the "timbre identification - single instruments" subtest, the low value for ± 1SS is 4.4, and the top value is 7.6; the low value for ± 2SS is 2.8, and the top value is 9.2; the low value for ± 3SS is 1.2, and the top value is 10.8. In the "melody identification" subtest, the low value for ± 1SS is 8.1, and the top value is 10.1; the low value for ± 2SS is 7.1, and the top value is 11.1; the low value for ± 3SS is 6.1, and the top value is 12.1. In the "melody in noise" subtest, the low value for ± 1SS is 15.2, and the top value is 19.6; the low value for ± 2SS is 13, and the top value is 21.8; the low value for ± 3SS is 10.8, and the top value is 24.

a. The Relations Between the MPT and the Variables

In this section, how the variables affect the total scores of the MPT is analyzed. These variables are the age, gender, educational level, interest level in music, frequency of listening to music by the participant, and the music genre listened to by the participant. By taking into consideration the above-mentioned variables, comparisons were conducted according to the total scores of the MPT among 100 volunteer participants; the relation between total scores and variables was examined statistically. As a result of the statistical applied tests, the cases in which *P* values were lower than 0.05, were accepted as significant**.** Results indicated that there was no relation between the total scores of the MPT and age (r: 0.176, p: 0.080) but the interest in music (r: 0.641, $P < 0.001$) and the frequency of listening to music (r: 0.479, $P < 0.001$) have an important effect on the total scores of musical perception.

Table 5. The relation between the variables of the total score of MPT and gender, educational level and music type

In Table 5, the relation between the variables of the total scores of the MPT and gender, educational level, and music type is shown. According to this, the difference in the total scores of MPT between female and male participants is found to be statistically significant ($p < 0.001$). As long as the educational level of the participants has improved, the total scores of musical perception have increased. The total scores of the MPT among participants who graduated from secondary school is 87.2 ± 17.4; the total scores among participants who graduated from high school is 89.3 ± 9.3. Meanwhile, the total scores among participants who had college or higher education is 100.4 ± 11.3. This situation has been found to be statistically significant ($p < 0.004$). The relation between the music type and musical perception score has received attention in our study. Accordingly, while the highest average musical perception was observed among the participants who listened to Turkish classical music (108.7 ± 0.8), those who listened to Arabesque scored lowest. There has been a statistically significant difference between music genres that patients listened to and the average total scores of MPT ($p < 0.001$).

Discussion

Clinical and scientific studies conducted with developing technology have indicated that speech recognition/discrimination and perception of individuals with hearing loss who use hearing aids and/or cochlear implants do not currently differ from individuals with normal hearing. Nevertheless, the technology for musical perception skills has not yet reached the desired level for individuals with hearing loss.[2-4] For this reason, the need to evaluate the musical perception skills of users, instead of evaluating the hearing and speech skills with technological devices such as hearing aids and cochlear implants has emerged as an issue.

In the study, the average total score among the participants on the MPT is 97.5 ± 12.2 (Min.: 69, Max.: 120). None of the 100 randomly chosen individuals scored the maximum scores, the best score being 120. This can be an indicator that not enough care had been given to music and of an inadequate auditory system and musical education in our country. It can also be an indication that certain sections of the MPT might be too difficult (for example, multiple instrument test and the number of instrument) and should be considered making easier. The participants who scored highest on the rhythm subtests (rhythm identification, rhythm recognition, rhythm discrimination and sensing rhythm). Similarly, in the study conducted by Uys and Van Dijk, the participants performed best on the rhythm section of the MPT, with the highest average score obtained for the rhythm identification task. They obtained an average score of 88.8% for the rhythm section of the test with individual scores ranging between 70% and 100%.[20] This has been an expected result because most of the participants listened to pop music – which is dominant in terms of rhythm and is the easiest genre to recognize in the music field. The participants performed worst at the "identification of number of instruments" subtest within the MPT. It

has been thought that the number of individuals who play any instrument is quite low in our country. It is a known fact that as the number of instruments increases, musical perception becomes difficult. In the study of Uys and Van Dijk, the worst performance was for the timbre section of the MPT.[20]

In the study, although there is no relation between the total scores of the MPT and age, the interest in music and the frequency of listening to music have an important effect on the total scores of musical perception ($p < 0.001$). This has been expected. As long as the interest in music and the frequency of listening to music improve, the musical perception skills are expected to improve. The relation between the variables of the total scores of the MPT and gender, educational level, and music type is shown in results. According to this, the difference in the total scores of MPT between female and male participants was found to be statistically significant ($p < 0,001$). As long as the educational level of the participants has improved, the total scores of musical perception have increased. This result has been found statistically significant ($p < 0.004$). It has been thought that this situation has positively affected cognitive skills like world knowledge, learning, and intelligence, along with increased educational level, which has led the total test scores of musical perception to increase.

In the study, the value of internal consistency of the MPT is 0.898. This value indicates that the test is reliable. In a similar manner, considering the correlation of test-retest parameters, both subtests and total score results show reliable results. These results show that Turkish MPT is a valid and reliable musical perception test for the Turkish people.

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Conflicts of interest

There are no conflicts of interest.

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