Development of The Music Background Experience Questionnaire

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Abstract

People with different levels of music experience have been reported to differ significantly in cognitive abilities such as verbal memory, phonological awareness and reading development. However, studies often comparing the cognitive ability between musicians and non-musicians. Among the non-musicians, there are differences in music experience levels. Besides, many non-musicians with higher music experience than musicians. However, at present there is no reliable and valid measure of music experience in the literature. In the current study we developed the Music Background Experience Questionnaire for use in the field of music psychology. An initial set of 45 items was compiled based on the literature and on semi-structured interviews with 10 musicians and psychologists. These items were then tested in a pilot study of 402 participants. Based on exploratory and confirmatory factor analysis, 11 items were selected and classified into the two dimensions of "music training" and "music contact." A sample of 2,228 participants (1,465 women, average age 27.62 years) then completed the new measure. A subsample of 49 completed the questionnaire again after three weeks. The internal consistency, test-retest reliability, structural validity and construct validity were strong. These strong psychometric properties suggest that the Music Background Experience Questionnaire is appropriate for use in music psychology research.

Introduction

Musical experience might affect inhibitory function[1-3], temporal information processing[4,5], cognitive aging[6-8] and other cognitive functions, and cortical structure and function[9-11]. For instance, Moreno *et al.* found benefits of musical training on inhibitory control, measured with behavioral tasks and ERPs, in children aged 4-6. Children who had four weeks of musical training performed better than the control group on a Go/No-go task, and had higher P2 amplitudes on No-go trials[1]. Vaquero *et al.* found that musical training enhanced asymmetry in the dorsal auditory pathway and arcuate fasciculus[9].

Studies on the effects of musical experience on cognitive and brain mechanisms are often illustrated by comparing musicians and non-musicians on performance or electrophysiological responses in various cognitive tasks[4,7,9] or before and after musical training[1,5,12]. However, non-musicians may nevertheless have musical experience, for example from listening to music, and this experience may influence cognitive and brain mechanisms[13,14]. There might even be non-musicians whose music-related abilities are superior to those of musicians. Comparing musicians and non-musicians on various cognitive tasks does not provide a rigorous test of the effect of musical experience on cognitive ability.

There is only one measure of music experience reported in the literature, namely Grison's Revised Criteria, compiled in 1972. The questionnaire has only one question. However, since there is no other research method to distinguish people with different levels of musical experiences, and this information is crucial for research related to music psychology, Grison's measure is still being used fifty years after it was developed[15,16]. The current study is designed to develop a music experience questionnaire with strong psychometric properties for use in this line of research.

Both music training and music contact (such as listening to music) are considered forms of musical experience, and both forms of experience should be associated with the cognitive and brain functioning found in the music profession groups in earlier research. In addition, it is possible that training in music-related skills (e.g., dance, cheerleading, rhythmic gymnastics, etc.) produces similar effects on cognitive ability and brain structure as music training does. For example, Li *et al.* found that both the music group and the dance group had enhanced functional connections in the insular network compared to the control group, and both groups also achieved higher empathy scores[17]. Therefore, questions about music-related training will also be included in the new measure. We expect that psychometric testing will identify three sets of items that can be meaningfully distinguished from each other as dimensions of music experience: music training, music contact, and music-related training.

In sum, this study adopted a strict process of questionnaire development to create a music experience scale based on rigorous and comprehensive psychometric testing. The newly developed measure should be helpful in future research on the characteristics and effects of different types and levels of musical experience.

Methods

Ethics declarations. The procedure in this study was approved by the ethical review board of the Institute of Brain and Psychological Sciences, Sichuan Normal University (NO. SCNU-211015) and according to the ethical guidelines of Helsinki Declaration. All participants took part in this study voluntarily with a written informed online consent form.

Participants. In the initial testing stage, 499 questionnaires were distributed through a data collection platform (www.wenjuan.com). Questionnaires that were completed in less than 1 min or more than 10 min were considered invalid and excluded, resulting in 402 questionnaires (80.56% of the original sample).

In the official test, questionnaires were distributed through a data collection platform (www.wenjuan.com), and 2,277 questionnaires were collected. There were 51 questionnaires were excluded. The final sample included 2,228 participants (97.84% of the original sample). According to the sample requirement of measurement[18], random sampling was conducted using SPSS 22.0 to select 10% of the data, creating a subsample of 211 (72 males, 34.1%; 139 females, 65.9%).

In the Test-Retest stage, 57 participants were invited to re-take the questionnaire three weeks later, and 49 completed the second administration (85.96%). Among them, 17 males accounted for 34.7% and 32 females accounted for 65.3%.

Item compilation. A list of 48 potential items was created by analyzing the literature and by conducting one-to-one semi-structured interviews with four groups of people: music teachers, college students majoring in music, people who had received music training, and people who listened to music regularly. Ten experts (5 experts with a Ph.D. in music and 5 experts with a Ph.D. in psychology) suggested and

made two rounds of revisions. This process resulted in a total of 45 items for the initial questionnaire. 7-point Likert scale was used. The questions covered music training (5 questions), music-related training (4 questions), music contact (26 questions), demographics (8 questions) and 2 lie detection questions. These initial items were then further analyzed to select the final items for the questionnaire.

Music contact contains two types of questions: exact time and agreement level with regard to the same content. music experience. For example, with regard to listening to music, participants were asked questions about exact time (average number of days that I listened to music per day in the past year (0 / 1 / 2 / 3 / 4 / 5 / 6 or more); average length of time that I listened to music per day in the past year (0-15 minutes / 15-30 minutes / 30-60 minutes / 60-90 minutes / 90 minutes - 2 hours / 2 - 3 hours / more than 3 hours).) and an agreement level question (I've been listening to music a lot in the past year (totally disagree / somewhat disagree / disagree / neutral / agree / more agree / totally agree).). Eventually, only the exact time type questions were selected based on the results of the initial factor loadings.

Tools and Methods. SPSS Version 22.0 was used for the statistics analysis and exploratory factor analysis (EFA). AMOS 24.0 was used for the confirmatory factory analysis (CFA).

Exploratory factor analysis was used to detect the underlying structure in the initial set of items. Items were excluded if their correlation with the total questionnaire score was less than $r = .2$; the mean item score exceeded plus or minus three standard deviations from the total score mean; or the item variation was greater than 15%. The Kaiser–Meyer–Olkin (KMO) value was used to test the correlations among items. Bartlett's test of sphericity was used to test the validity of the independent values taken between items. Principal Component Analysis using varimax rotation was used to extract factors. A factor was extracted when the eigenvalue was greater than 1. The number of factors extracted was not limited. Items with factor loadings less than 0.30 or communalities less than 0.20 were deleted, as well as items that had factor loadings on two or more dimensions. This exploration process was repeated several times until coefficient of variation stabilized.

The reliability analysis included the internal consistency reliability and the test-retest reliability. Internal consistency reliability is alpha for each subscale and overall scale. There was an interval of 20 days between the first test and the retest. Confirmatory factor analysis was used as a test of construct validity. The fit indexes were: ratio of cardinality to degrees of freedom (χ^2/df), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Root-Meansquare Error of Approximation (RMSEA), Average Variance Extracted (AVE), and Composite Reliability (CR). GFI, AGFI, TFI, CFI fall in the range of 0-1, and a value closer to 1 indicates a better fit. A value of the ratio of cardinality to degrees of freedom χ^2/df that is less than 5 indicates an acceptable fit and a value less than 3 indicates a good fit. When the RMSEA is below 0.08, the model fit is better. AVE greater than 0.5 indicates that the latent variables have adequate convergent validity, and CR greater than 0.8 indicates that the items highlight the qualities.

Results

Demographic information. The demographic information is shown in Table 1.

Table 1. Demographic variables

Characteristic	Initial test	Official test	Test-retest
	N = 402	*N* = 2,228	*n* = 49
Gender			
Male	104 (24.9%)	763 (34.2%)	72 (34.1%)
Female	298 (74.1%)	1,465 (65.8%)	139 (65.9)
Age	M = 22.47, SD = 6.55	M = 27.62, SD = 7.20	M = 27.18, SD = 6.62
Academic qualifications			
Below undergraduate	52 (12.9%)	356 (16.0%)	31 (14.7%)
Undergraduate	287 (71.4%)	1,667 (74.8%)	159 (75.4%)
Masters	56 (13.9%)	185 (8.3%)	21 (10.0%)
Ph.D.	7 (1.7%)	20 (0.9%)	0 (0.0%)
Music-related major			
Yes	188 (46.8%)	678 (30.4%)	71 (33.6%)
No	214 (53.2%)	1,550 (69.6%)	140 (66.4%)
Any family members with music-related majors			
Yes	191 (47.5%)	1,093 (49.1%)	106 (50.2%)
No	211 (52.5%)	1,135 (50.9%)	105 (49.8%)
Average monthly household income			
Below 3000 RMB	26 (6.5%)	84 (3.8%)	10 (4.7%)
3000 - 5000 RMB	90 (22.4%)	195 (8.8%)	16 (7.6%)
5000 - 8000 RMB	102 (25.4%)	405 (18.2%)	39 (18.5%)
8000 - 12000 RMB	96 (23.9%)	566 (25.4%)	47 (22.3%)
12,000 - 20,000 RMB	59 (14.7%)	567 (25.4%)	58 (27.5%)
Above 20,000 RMB	29 (7.2%)	411 (18.4%)	41 (19.4%)
Only child in the family			
Yes	168 (41.8%)	1,160 (52.1%)	115 (54.5%)
No	234 (58.2%)	1,068 (47.9%)	96 (45.5%)

Place of origin			
Urban	226 (56.2%)	1,547 (69.4%)	149 (70.6%)
Rural	176 (43.8%)	681 (30.6%)	62 (29.4%)

Initial test. After conducting exploratory factor analysis, four items were eliminated. The KMO coefficient was 0.903, indicating that there was no significant difference in the degree of correlation between the questionnaire items. The Bartlett's test of sphericity chi-square value was 2968.079, with $df = 55$, $p < 0.001$, and the spherical hypothesis were rejected. Together, these results indicated that the data were suitable for confirmatory factor analysis.

Based on the confirmatory factor analysis, 20 items with small factor loadings (< 0.3) or small commonalities were deleted. The factor loadings of the 11 test items that were finally retained were all greater than 0.30, and a total of two factors were extracted. Factor 1 included items about students' music training and music-related training, so it was named "music training"; Factor 2 included items about the time students spent with music in daily life, so it was named "music contact."

The results of the confirmatory factor analysis are shown in Table 2.

Table 2. Questionnaire items and factor loadings from confirmatory factor analysis

Item	Music training	Music contact
Q1 Duration of learning music skills	0.799	
Q2 Number of musical skills mastered	0.837	
Q3 Duration of daily music training	0.870	
Q4 Average number of days of music training per week	0.866	
Q5 Duration of training in sight-reading and ear training	0.884	
Q6 Duration of daily music-related training	0.816	
Q7 Number of music-related skills mastered	0.844	
Q8 Average number of days per week in music-related training	0.859	
Q9 Average number of days per week listening to music		0.730
Q10 Average number of days per week that music is played at work, study and living places		0.772
Q11 Average number of days per week watching videos with background music		0.697
Eigenvalue	5.777	1.697
Variance contribution (%)	52.520	15.423
Cumulative contribution (%)	52.520	67.943

Official test. *Reliability analysis.* The internal consistency reliability of the questionnaire, the music training dimension, and the music contact dimension were α = 0.903, 0.951, and 0.777, respectively. The three-week test-retest reliability was r = 0.742. These results indicated that the questionnaire had good reliability and stability across time.

Validity analysis. The confirmatory factor analysis model was constructed using Amos 24. See

Figure 1 for details.

The results of the confirmatory factor analysis are shown in Table 3. The results showed that the TLI, IFI, and CFI values were greater than 0.90, the χ^2/df value was less than 3, the overall fit level of the model was good.

Table 3. Overall model fitting indexes

	χ^2/df	RMSEA	CFI	IFI	TLI
Single-factor model	68.274	0.174	0.846	0.846	0.807
Two-factor model	1.885	0.065	0.980	0.980	0.973

After the model correction, the questionnaire had good discriminant validity with a corrected value of 0.453 ($p < 0.01$). See Table 4 for details.

Table 4. Discriminant validity

	A (Music training)	B (Music contact)
A (Music training)	0.702	
B (Music contact)	0.453**	0.596
AVE square root	0.838	0.772

** $p < 0.01$

The factor loadings of each component are shown in Table 5.

Table 5 Factor loadings and convergent validity

Path	Estimate	AVE	CR
A8	0.813	0.702	0.949
A7	0.837		
A6	0.883		
A5	0.914		
A4	0.833		
A3	0.833		
A2	0.814		
A1	0.765		
B3	0.615	0.596	0.813
B2	0.864		
B1	0.815		

The two questionnaire dimensions showed a low correlation with each other, but each showed a high correlation with the total score. It indicate that the two dimensions are valid measures of music training and music contact, respectively, and that the questionnaire has good structural validity. See Table 6 for details.

Table 6. Correlation matrix of dimensions scores and total scores

	Total score	Music training	Music contact
Total score	1		
Music training	0.951**	1	
Music contact	0.523**	0.233**	1

Discussion

The results of the study show that the internal consistency reliability of the questionnaire was 0.903 and the test-retest reliability was 0.742. The correlation coefficient between music training and music contact was 0.233, and the total score of both the correlation coefficient was 0.951 and 0.523. The TLI, IFI and CFI values of confirmatory factor analysis were 0.980, 0.980 and 0.973 respectively; the χ^2/df value was 1.885. The corrected value of discriminant validity was 0.453 ($p < 0.01$). Until now, researchers have relied on a single-item measure to assess music experience. In the current study we developed a comprehensive measure called the Music Background Experience Questionnaire. The questionnaire assesses music training and music contact, and has strong psychometric properties. This measure will be helpful to researchers in the field of music psychology.

In the design of the preliminary questionnaire, we chose items to represent three dimensions of music experience. However, exploratory and confirmatory factor analysis only identified two factors. Music training and music-related training were part of the same factor, and music contact was the other factor. The reason may be that although music training and music-related training have different effects on cognitive ability and brain development[17], they are consistent with the increase of music experience. The difference in their influence on individuals may be due to factors other than music experience. For example, dance training causes brain changes in the sensory motor network, while music training does not[17], so music training and music-related training cannot be divided into two different dimensions of music experience. The two aspects of music experience might also be part of the same factor if many participants had both music training and music-related training. The items representing the other dimension of music experience, namely music contact, asked about exact time as well as agreement level. However, the agreement level items were excluded by exploratory factor analysis. Therefore the final music contact dimension assesses exact time but not agreement level.

Although the study used a strict questionnaire preparation process and showed that the Music Background Experience Questionnaire has strong psychometric properties, it also has some limitations. First, it is not clear whether similar results would be obtained in different cultural backgrounds. In the future, cross-cultural studies can be carried out to verify the cross-cultural consistency of the questionnaire. Second, due to the Covid-19 pandemic, people's music contact and training may be different from those during the pre-pandemic period (e.g., there are fewer concerts to perform in and attend). Further research is needed once pandemic-related social restrictions are lifted.

Declarations

Competing interests

The authors declare no competing interests.

Author contributions

W.L. constructed the research idea. All authors of this paper contributed to the design of the work. D.M., H.J. and X.J. collected and analyzed the data. W.L. wrote the manuscript. J.L. provided critical revisions.

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Figures

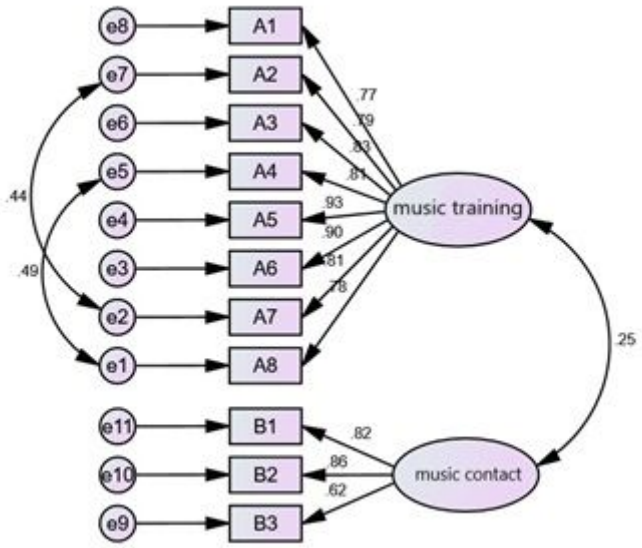

Figure 1

Questionnaire structure based on confirmatory factor analysis

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