Development of a Test to Objectively Assess Perceptual Musical Abilities

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Abstract. Possibilities for a fine-grained and objective measurement of individual differences in musical abilities are limited at present. A common approach to determining musical competence therefore is to rely on information about the extent of individuals' musical training. Yet relying on musicianship fails to identify musically untrained individuals with musical skill. To counteract this limitation, we developed a test-battery which can be taken by musicians and non-musicians alike, and which measures perceptual musical skills across multiple domains: Tonal (Melody, Pitch), Qualitative (Timbre, Tuning), Temporal (Rhythm, Rhythm-to-Melody, Accent, Tempo) and Dynamic (Loudness).

Keywords: music, ability, talent, perception, individual differences, melody, pitch, timbre, tuning, rhythm, accent, tempo, loudness

1 The Development of a New Music Test

Across disciplines, scholars are increasingly interested in assessing and understanding individual differences in musical ability. One reason for the current interest in music and the mind are the relationships between musical abilities to non-musical traits, ranging from empathy to dyslexia. For example, problems in rhythm perception have been recently found to relate to reading impairments, and there is reason to believe that training of rhythmic processing capacities could act as a remedy for dyslexia [1]. A more complete picture of the links between musical and non-musical traits may also shed light on another hotly debated issue, the evolutionary origins of music. Unfortunately, such a tool does not currently exist. It is not that various aspects of music perception and production had not been extensively investigated – they have [e.g., 2]. What has been missing is interest in the development of a psychometrically sound and construct validated test, capable of diagnosing individual differences in musical ability. Most musical aptitude tests were developed between 1920 and 1970 and originated in music education research. The primary goal of these tests was to identify the potential for musical accomplishment in young children [e.g., 3, 4, 5, 6, 7]. These tests however are inaccessible or have not proven to be useful enough for use in contemporary research.

We have developed a new test-battery using a web-platform, for measuring individual differences in perceptual musical skills, rectifying some of the shortcomings in earlier tests. To this end, we felt it necessary to expand the range of perceptual musical skills usually omitted from previous tests. In addition to tasks testing tonal memory and rhythmic skills, our battery includes tasks testing skills in the perception of tempo, timbre, tuning, pitch, accent, and loudness. These parameters

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are considered of prime importance in the expression and perception of musical performances [8, 9]. Our test-battery provides a music background questionnaire and a non-music related questionnaire in addition to the listening test. This not only pins down the specific music factor(s) or experience that might have facilitated music perceptual skill, but also further informs us as to whether there are other non-musical activities that share transferable skill properties. Also worth noting are the main differences between our test-battery and the Goldsmiths Musical Sophistication Index (Gold-MSI) [10] – specifically that our test-battery measures nine basic judgments on perceptual listening skill (using the same/different paradigm) whereas the Gold-MSI measures perceptual skills on melody discrimination, rhythm accuracy and musical genre classification modeled on previous research. Although the authors of Gold-MSI have provided evidence of internal consistency reliability for their survey questionnaire, other areas of psychometric properties such as test-retest reliability and test-validity are yet to be reported either for the music test or survey questionnaires. On the other hand, our test-battery has shown to be reliable and validated.

It has showed satisfactory psychometric properties for the composite score (internal consistency and tests-retest analysis >= .89) and fair to good ones for the individual subtests (.62 - .83) (see Table 1). Convergent validity was established with the relevant dimensions of Gordon's Advanced Measures of Music Audiation [11] and Musical Aptitude Profiles (Melody, Rhythm, Tempo) [4], the Musical Ear Test (Rhythm)[12], and content validity with sample instrumental sounds (Timbre) (see Table 2). There was a moderately strong relationship between test performance and self-reported musical training, providing additional support to the test's validity but also suggesting that the current instrument accounts for variance in musical skills beyond self-reported musicianship status and previous musical aptitude tests. The current work also suggests that performance on the nine subtests may be subtended by two higher order perceptual abilities: an analytical and a sensory perceptual musical ability. The analytical factor is related to memory capacity and the sensory factor refers to quick attention capacity and judgment. We also found the rhythm subtests from our test-battery are related to spatial or logic reasoning ability.

This new test-battery is very useful in many ways. First, the battery is more comprehensive compared to previous tests comprising of nine music perceptual tests as well as music background questionnaires. Thus it is a potential tool for investigating a wider range of perceptual skills and can go beyond the conventional focus on rhythm and tonal memory. Second, as the test-battery was developed more recently than previous tests, it is more sensitive with current concepts of music perception and cognition. Third, high standards for test construction and validation were applied.

In conclusion, we hope that the current battery can provide a basis from which a richer scientific narrative on musical ability and its measurement will eventually emerge.

Table 1. Split-Half Reliability and Test-Retest Coefficient for Subtests and Composite Score

Test	Internal Consistency	Test-Retest
Tuning	.82	.68**
Rhythm-to-Melody	.80	.82**
Pitch	.78	.77**
Timbre	.73	.68**
Melody	.71	.77**
Loudness	.68	.83**
Rhythm	.67	.62**
Accent	.66	.71**
Tempo	.64	.81**
COMPOSITE	.89	.90**

Note. Sample size for internal consistency was N=56; sample size for Test-Retest was N=20; ** $p < 0.01$ (2 tailed)

Table 2. Correlation between AMMA, MET, MAP, Timbre (Mono) with the New Music Test (Convergent and Content Validity)

Test	Tonal (AMMA)	Rhythm (AMMA)	Rhythm (MET)	Tempo (MAP)	Timbre (Mono)
Melody	**.68****	.60**	.46**	.60**	.23
Rhythm-to-Melody	.43**	**.42****	**.64****	.44**	.33*
Rhythm	.51**	.44**	**.60****	.37**	.23
Accent	.48**	.37**	.37**	.44**	.24
Tempo	.33*	.33*	.22	**.33***	.36**
Timbre	.30*	.27	.15	.32*	**.53****
Tuning	.48**	.41**	.28*	.47**	**.41****
Pitch	.34*	.33*	.12	.37**	**.49****
Loudness	-.10	-.11	-.05	.05	**.40****

Note. N=52; Target validity correlations are in bold fonts. AMMA= Advanced Measures of Music Audiation, MET= Musical Ear Test, MAP = Musical Aptitude Profile
* $p < 0.05$; ** $p < 0.01$ (2 tailed)

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