The Effect of Relaxation Techniques on Student Music Sight-Reading and Short-Term Learning under Test-Induced Performance Anxiety

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ABSTRACT

There is a direct correlation between music sight-reading and instrumentalists' aural perception, math and reading achievement scores, field-independent cognitive style, written word sensory mode preference, and GPA (Bergman, Darki, & Klingberg, 2014; Ciepluch, 1988). Sight-reading is dependent upon short-term memory functionality (Massaro, 1972; Moss, Myers & Filmore, 1970) and time-based recall (Williams, 1975), and may be adversely influenced by performance anxiety (Wilson-Roland, 2002). Relaxation techniques were suggested as a possible strategy in order to reduce the levels of performance anxiety (Wilson-Roland, 2002). A small-scale pilot study was initiated in order to develop a method to test the effectiveness of this strategy.

Keywords

Sight-reading, student achievement, relaxation, performance, short-term memory, anxiety.

INTRODUCTION

Research provides supporting evidence that music sight-reading is a critical component of music literacy, as better sight-readers tend to be better performers (Lehmann & McArthur, 2002). It further emphasizes the interrelationship between brain areas and their influence on each other's development and functionality (Near-transfer Theory: Salomon, & Perkins, 1989) as it occurs especially in literacy-based music instruction (Gromko, & Poorman, 1998; Hetland, 2000; Rauscher, Shaw, Levine, Wright, Dennis, & Newcomb, 1997).

Gardner suggested that intelligence is not a single, monolithic property of mind, but multiple separate intelligences that are correlated at functional level (Gardner, 1983). Newer research points to the fact that intelligence is broad-based, fluid and multifaceted, and that music intelligence is a composite intelligence that draws on, and enhances development in, other domains providing evidence in support of the near-transfer effects of music instruction (Gromko, 2004). A similar model is applied to sight-reading which, according to research, appears to be not a skill in itself but an ability dependent on a set of interdependent sub-skills and variables (Lehman, & McArthur, 2002). These variables can act as predictors for the ability to proficiently sight-read (Elliott, 1982) and while these predictors have different levels of accuracy, it has been found that there is a strong, positive relationship between general sight-reading ability and the ability to sight-read rhythm patterns (Elliott, 1982).

Sight-reading can be improved by mastering specific sub-skills and variables as it is dependent on short-term memory functionality. Both visual (Massaro, 1972) and symbolic (Moss, Myers, & Filmore, 1970) types of short-term memory involved in sight-reading are affected by the position of pitches within a given sequence, the overall length of a sequence and the amount of time before recall has a direct effect on short-term memory (Williams, 1975). Structured sequential learning activities that employ tonal pattern content, harmonization and vocalization are suggested along with an emphasis on aural skills development before progressing to reading skills activities (Grutzmacher, 1987) as influencing positively sight-reading proficiency.

Music sight-reading ability can be predicted by a combination of cognitive abilities (Gromko, 2004). The relevant information contained in musical notations is not derived through feature analysis of the notes but through analysis of the spatial location of the notes (Sergent et al., 1992). As a result, deficit in spatial processing impairs the ability to sight-read (Douglas, & Bilkey, 2007); consequently, spatial-processing tasks can be a predictor for sight-reading proficiency. Significant correlation was found between music sight-reading and instrumentalists' aural perception, math and reading achievement scores, field-independent cognitive style, written word sensory mode preference, and GPA (Ciepluch, 1988) suggesting that improving sight-reading skills may have a direct beneficial effect on all these aspects of cognitive development.

While research found no connection between the sight-reading ability and performance skills, sight-reading proficiency, short-term retention and performance are all directly affected by performance anxiety. Research done on performance anxiety found that "socially-prescribed perfectionism was more strongly associated with debilitating performance anxiety than self-oriented perfectionism (Wilson, & Roland, 2002)." The importance of expectation-based anxiety induced by external standards is supported further by another finding (Wilson, & Roland, 2002) according to which "public performance anxiety is more anxiety-evoking than private performance." As performance anxiety seems to influence directly the ability to sight-read, the same study (Wilson, & Roland, 2002) suggests that different types of cognitive-behavioral intervention can reduce anxiety: "strategies include relaxation, adopting a performance routine. . . ." Elliott (1982) found that sight-reading is related to rhythmic reading and performance abilities and, as such, supports the finding that anxiety-affected performance has a negative influence on sight-reading abilities.

HYPOTHESIS

If self-oriented perfectionism (Parncut, & McPherson, 2002), the private performance setting (Wilson, & Roland, 2002) and the exposure to cognitive-behavioral intervention (Wilson, & Roland, 2002; Nagel, Himle, & Papsdorf, 1989) such as relaxation strategies reduces performance anxiety (Bourne, 1995; Nagel, Himle, & Papsdorf, 1989; Roland, 1994, & 1997; Hanton, & Jones, 1999) then subjects testing in these conditions should show measurable improvement in their performance abilities when tested against a control group.

MATERIALS AND METHODS

This study intended to induce a high level of performance anxiety on test subjects, then subject the test group to a cognitive-behavioral intervention such as suggestion-induced

relaxation in order to measure against a control group if variables such as rhythmic reading and performance abilities are significantly improved. Reducing performance anxiety through a cognitive-behavioral intervention for the test group may have a positive influence on performance abilities as sight-reading proficiency is dependent upon short-term memory functionality (Massaro, 1972; Moss, Myers, & Filmore, 1970) and time-based recall (Williams, 1975), both negatively influenced by performance anxiety. The self-oriented perfectionism is specific to professional musicians and directly influences performance anxiety at a lower degree than socially-prescribed perfectionism (Parncut, & McPherson, 2002). In order to account for all required variables, the test subjects performed without an audience, had ten minutes to memorize a given music fragment in a normal practice room and were subject to cognitive-behavioral intervention.

Demographic information

The subjects for this study were full-time graduate and undergraduate string instrument students from Bowling Green State University in Ohio. Six subjects volunteered to participate (three violin students, two viola students and one violoncello student), five completed the study. From the pool of participants two subjects were first-year graduate students and three subjects were terminal year undergraduate students meaning that their instrument mastery was at a comparably similar level. One subject was female, four subjects were male. Each participating subject was screened beforehand so as to meet requirements such as a minimum of ten years of instrument training and at least two levels of aural skills university training in an attempt to control variables such as technical and pitch representation abilities. All subjects were enrolled in applied lessons at the time of the pilot study in addition to performing both solo and in various ensemble settings.

Materials

The research materials consisted of a *Jury Form* (Appendix 1) containing a special rubric for a *Suggestion-Response Test*, a *Sight-Reading Test* (Appendix 2a) and a *Short-Term Retention Test* (Appendix 2b). The materials were designed specifically to meet requirements such as difficulty level, musical idiom, unfamiliarity and content specificity.

The jury form was used to assess and record subjects' performance accuracy in terms of rhythm, pitch, dynamics, articulations, musicality and confidence on a 1 to 5 scale for both the sight-reading and the short-term retention test. The jury form was further used for recording subjects' level of response to suggestion-based instructions.

The sight-reading and the short-term retention tests were designed using an atonal idiom so as to avoid familiar melodic, harmonic and finger patterns specific to tonal idioms and consequently to induce a high level of anxiety in the test subjects.

Preference was given to intervals such as minor and major second, augmented fourth, major seventh and minor nineth during the compositional process of the musical fragments used for testing purposes Consonant intervals were mostly nested among dissonant intervals so as to minimize their familiarity in terms of melodic contour and finger patterns. Complex rhythms and rhythmical divisions, dynamics, articulations and string instrument-specific bowing were included to increase specificity regarding phrasing, technique and overall musicianship. The music fragments were designed to match a high degree of difficulty when performed either in a sight-reading session or with the purpose of memorization within a short span of time. Both music tests were written

in three different clefs (G clef on the second staff line, C clef on the third staff line and F clef on the fourth staff line) in order to accommodate all participating instruments. The melodic content is identical in all three clefs, although the music in the F clef is transposed an octave lower to adjust the range and difficulty level to one similar to the other participating instruments.

Methods

The experiment was administered by a jury consisting of two volunteer judges who chose randomly the members of both the test and the control groups from the total pool of participants.

All subjects (n=5) were placed in different practice rooms, isolated from each other, while the judges delivered each section of the experiment to each participant in their respective rooms, all throughout the experiment. Timed sections were measured using a portable electronic timer.

All subjects participated first in the sight-reading test (Appendix 2a) and the results were recorded on the jury sheet (Appendix 1). This segment of the test measured their sight-reading proficiency and the initial levels of anxiety by recording its impact on subjects' motor coordination and invariably their ability to accurately reproduce music variables such as rhythm, bowing, dynamics, etc.

Consequently, all subjects were administered a suggestion-response test in order to measure their ability to respond to suggestion-specific input. The suggestion-response variable was assessed with the idea that a higher score in this area could be an indicator of a potentially better response to relaxation suggestions. One of the jury members delivered the oral instructions for this section of the study while the control group continued with the short-term retention test.

The suggestion-response test consisted of asking the test subject to rest the right-hand palm on the tester's right-hand index pointing upwards while at a normal ninety-degree forward arm angle as the tester was facing the subject, both standing. Afterwards, the tester released suddenly the support and watched if the subject's arm immediately fell completely under its own weight as a result of implementing fully the relaxation instruction, fell slowly or only partially, or did not fall at all. The results were recorded on the jury sheet on a 0 to 2 scale where 0 = no response, 1 = medium response and 2 = full response. For a greater degree of accuracy, marks of ¼ in value were added in the form of dots between 0-1 and 1-2, accounting for smaller values such as .25, .5 or .75.

Research literature found a direct correlation between the sight-reading prowess and performance abilities, as sight-readers tend to be better performers (Lehmann, & McArthur, 2002). As sight-reading is inverse-proportionally affected by performance anxiety, a behavioral-cognitive intervention to lower anxiety in testing subjects consists of relaxation methods (Bourne, 1995; Nagel, Himle, & Papsdorf, 1989; Roland 1994, & 1997; Hanton, & Jones, 1999). As a consequence, the suggestion-response test was followed by a 5-minute suggestion-based relaxation intervention using a standard mindfulness meditation technique for the testing group while the control group received none. The testing subjects received orally-delivered suggestion-based instructions with regard to establishing proper posture, awareness of the hands, body and breath as well as awareness of increasingly deeper levels of profound relaxation.

Consequently, both the control group (n = 2) and the test group (n = 3) were given a second sight-reading test and the short-term retention test (Appendix 2b) consisting of a second musical fragment which they had to learn and perform by memory in a 10-minute time span, with great attention to details such as rhythm and rhythmical divisions, dynamics and bowing. The scores received during this phase were averaged considering the direct relationship between sight-reading proficiency and performance abilities (Lehmann, & McArthur, 2002).

Research suggests that the pitch storage capability is +/- 6 discrete pitches and that time and item decay (interference) has a direct influence on retention (Massaro, 1972). As a result, the test materials were designed to be significantly greater in length (6 measures containing 68 and respectively 66 pitch representations per musical example) and to feature difficult rhythm patterns and bowing that challenge the time-span of memory response to the different tasks involved, causing higher levels of performance anxiety in the test-takers.

Instruction using tonal patterns through the use of harmonization and vocalization activities improves the melodic sight-reading skills more than traditional methods in which notes are individually identified from notation and without harmonization and vocalization activities (Grutzmacher, 1987). Subjects who can perceive similarities and differences between pairs of tonal and rhythmic patterns are better music readers (Gromko, & Russel, 2002). As the experience level required from the test participants assumes that they were already properly and efficiently established in a tonal training idiom as well as good aural and reading skills, the choice for longer atonal sample tests with intricate dynamic, rhythmic and technique requirements further increased the test-induced performance anxiety levels.

All testing result data was initially recorded on the jury sheet, then processed both in a table format (Table 1. Research Data Processing) as well as a graphical representation (Figure 1. Comparison of Research Data). The final scores represent the average of judges' assessment in each category compared against a maximum possible score of 30 points for each subject in each of the two music tests. All italicized numbers in the table represent sums for both horizontal and vertical categories as well as for each group separately and together. The difference represents operations of subtraction where the first scores are extracted from the first scores while the overall evolution of each subject during the experiment is expressed in percentages.

RESULTS

All subjects participating in the study showed improvement from the sight-reading test to the sight-reading/short-term memory retention test, with or without the five-minute relaxation therapy; as a consequence the hypothesis was not confirmed.

Furthermore, all subjects increased in retention capacity as shown by their second set of scores (Figure 1. Comparison of research data), regardless of the relaxation therapy and despite the fact that all of them showed signs of anxiety and discomfort in performing atonal music by memory in a short time span.

Table 1. Research Data Processing

Subjects	Test 1 Sight-Reading						Score 1	Test 2	Rel. Instr.	Test 3 SR/STRT							Score 2		Evolution
#	Rhythm	Pitch	Dynamics	Articulations	Musicality	Confidence		Suggestion-Response	5 minutes	Group	Rhythm	Pitch	Dynamics	Articulations	Musicality	Confidence		Difference	%
1	5	5	3.5	4	5	4	*26.5*	0.75	5	T	5	5	4	5	5	5	*29*	2.5	8.3
2	3.5	3	1	3	3	3	*16.5*	2	5	T	4	4	2	3	5	5	*23*	6.5	21.6
3	3.5	4.5	1	4	3	4	*20*	1.25	5	T	5	5	4.5	5	5	4.25	*28.75*	8.75	29.1
4	3	3	2	3	2.5	3	*16.5*	1.75	0	C	4	4.5	3	3	5	5	*24.5*	8	26.6
5	3	5	3	2.5	4	3	*20.5*	0.5	0	C	5	5	2	4	5	5	*26*	6.5	21.6
TT	*12*	*12.5*	*5.5*	*11*	*11*	*11*	*63*			TT	*14*	*14*	*10.5*	*13*	*15*	*14.25*	*80.75*	17.75	
TC	*6*	*8*	*5*	*5.5*	*6.5*	*6*	*37*			CC	*9*	*9.5*	*5*	*7*	*10*	*10*	*50.5*	14.5	
TA	*18*	*20.5*	*10.5*	*16.5*	*17.5*	*17*	*100*			TA	*23*	*23.5*	*15.5*	*20*	*25*	*24.25*	*131.25*	31.25	20.83

Legend: #1-5 = test participant subjects; TT = total test group; TC = total control group; TA = total all groups; T = test group; C = control group; S-R = suggestion response; SR/STRT = Sight-Reading/Short-Term Retention Test; R = Results.

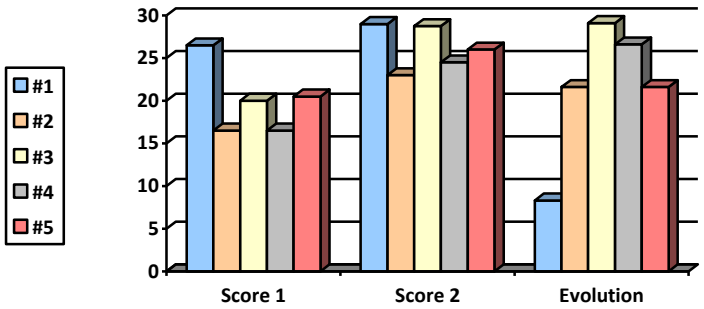


Figure 1. Comparison of research data (test vs. control subjects)

IMPLICATIONS FOR MUSIC EDUCATION

Anxiety may not be debilitating until reaching a critical level, especially in private performance (Wilson & Roland, 2002). As such, strategies geared towards learning to control anxiety rather than completely eliminate it might set the tone for better performances that retain the energy and keep the participants engaged in the momentum.

While sight-reading of pitches was not obviously related to anxiety, refined motor coordination may interfere with the sight-reading process. Strategies aimed at perfecting the instrumental technique will yield better sight-reading results. Also, even though the short-term relaxation for a non-regular practitioner was not obviously related to higher achievement, it is widely accepted that relaxation affects directly the level of stress hormones and as such it may be actively pursued as a long-term behavioral-cognitive strategy with long-lasting and extensive benefits.

SUGGESTIONS FOR FURTHER RESEARCH

Relaxation treatment should be an on-going practice, a habitual pattern so as to be effectively employed as a behavior-cognitive strategy. As such, participants should be tested at the beginning and the end of such long-term training.

Instructions for relaxation technique could be delivered from a tape in order to avoid changes in speech patterns or voice inflexions due to involuntary emotional involvement or response to testing variables. However, it is possible that aural calibration might need to be considered so as the subjects to adjust the audio levels to their most comfortable levels.

The study may assess the overall basic levels of stress and anxiety the subjects come to begin with, as well as the evolution of their stress levels during the test taking process. It may also consider the minimum time span required for a test participant in order to reach a state of relaxation.

The test could be organized within the context of a public performance so as to measure its impact on a situation inducing very high levels of anxiety. In order to exert even more control over the testing variables, prior training of the subjects in relaxation techniques should be taken into consideration during testing.

Furthermore, the test may benefit from a larger pool of subjects, a longer period for the relaxation technique which may allow the body to reach critical levels of relaxation, and from imposing a set tempo such as Qt.=60 which amounts for approximately 4 seconds per measure.

REFERENCES

Bergman Nutley S, Darki F, Klingberg T. (2014). Music practice is associated with development of working memory during childhood and adolescence. Front Humanistic Neuroscience. 2014 Jan 7; 7:926. Epub 2014 Jan 7.

Bourne, E. (1995). The anxiety and phobia workbook. Oakland, CA: New Harbinger.

Cieplucl, G. M. (1988). Sightreading Achievement in Instrumental Music Performance, Learning Gifts, and Academic Achievement: A Correlation Study. (Doctoral dissertation, The University of Wisconsin - Madison). Dissertation Abstracts International, 49(06), 1389A.

Elliott, Charles A (1982). The Relationship Among Instrumental Sight-Reading Ability and Seven Selected Predictor Variables. Journal of Research in Music Education, Vol. 30, No.1 Spring, pp.5-14.

Douglas, Katie M., Bilkey, David K (2007). Amusia is associated with deficits in spatial processing.

Nature Neuroscience 10, 915 - 921 (2007), Advance Online Publication, published online: 24 June 2007.

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Gromko, J., E. (2004). Predictors of Music Sight-Reading Ability in High School Wind Players. Journal of Research in Music Education, Vol.52, No.1 Spring, pp. 6-15.

Gromko, J. E., & Poorman, A. S. (1998). The effect of music training on preschooler's spatial-temporal task performance. Journal of Research in Music Education, Vol. 46, 137-181.

Grutzmacher, Patricia Ann (1987). The Effect of Tonal Pattern Training on the Aural Perception, and Melodic Sight-reading Achievement of First-Year Instrumental Music Students. Journal of Research in Music Education, Vol.35, No.3 Autumn, pp. 171-181.

Guettler, K., & Hallam, S. (2002). String Instruments. In R. Parncutt & G. McPherson (Eds.). The science and psychology of music performance (pp. 303-317). NY: Oxford University Press.

Hanton, S., & Jones, G. (1999). The acquisition and developemnt of cognitive skills and stgrategies: 1. Making the butterflies fly in formation. Sport Psychologist, 13, 1-21.

Hetland, L. (2000). Listening to music enhances spatial-temporal reasoning: Evidence for the “Mozart-Effect.” The Journal of Aesthetic Education, 34, 105-148.

Lehman, Andreas C. & McArthur V. (2002). Sight-Reading. In R. Parncutt & G. McPherson (Eds.). The science and psychology of music performance (pp. 135-150). NY: Oxford University Press.

Massaro, D. W. (1972). Preperceptual images, processing time, and perceptual units in auditory perception. Psychological Review, 1972, 79, 124-145.
Moss, S.M., Myers, J.L. & Filmore (1970). T. Short-term recognition memory of tones. Perception & Psychophysics, 7: 369. doi:10.3758/BF03208669.
Nagel, J., Himle, D., & Papsdorf, J. (1989). Cognitive-behavioral treatment of musical performance anxiety. Psychology of Music, 17(1), 12-21.
Nozari, A. Y., & Siamian, H. (2015). The Relationship between Field Dependent-Independent Cognitive Style and Understanding of English Text Reading and Academic Success. Materia Socio-Medica, 27(1), 39–41. http://doi.org/10.5455/msm.2014.27.39-41.
Parncut, Richard & Gary McPherson (2002). The Science and Psychology of Music Performance: Creative Strategies forTeaching and Learning. NY: Oxford University Press.
Rauscher FH1, Shaw GL, Levine LJ, Wright EL, Dennis WR, Newcomb RL (1997).Music training causes long-term enhancement of preschool children's spatial-temporal reasoning. Neurological Resource 1997 Feb;19(1):2-8.
Roland, D. (1994). How professional performers manage performance anxiety. Research Studies in Music Education, 2, 25-35.
Roland, D. (1997). The confident performer. Sydney: Currency.
Sergent J., Ohta S., & MacDonald B. (1992). Functional neuroanatomy of face and object processing: a positron emission tomography study. Brain 115:15–36.
Salomon, G., & Perkins, D. N. (1989). Rocky roads to transfer: rethinking mechanisms of a neglected phenomenon. Educational Psychologist, 24, 113–142.
Williams, D. B. (1975). Short-Term retention of pitch sequence. Journal of Research in Music Education, Vol.23, No.1 Spring, pp.53-66.
Wilson, G., & Roland, D. (2002). Performance anxiety. In R. Parncutt & G. McPherson (Eds.). The science and psychology of music performance (pp. 47-61). NY: Oxford University Press.
Witkin, H., Moore, C., Goodenough, D., & Cox, P. (1977). Field-Dependent and Field-Independent Cognitive Styles and Their Educational Implications. Review of Educational Research, 47(1), 1-64. Retrieved from http://www.jstor.org/stable/1169967.

Appendix 1. Jury Form

JURY FORM

General information

Name: _____ Years of instrument training: _____
Currently enrolled full-time in the CMA: ☐
Currently taking lessons: ☐
Currently performing solo and ensemble: ☐
Randomly selected for: control group 1 ☐ test group 2 ☐

Testing procedure

Test No.1: Sight-Reading

Rhythm 1 2 3 4 5	Pitch 1 2 3 4 5	Dynamics 1 2 3 4 5
Articulations 1 2 3 4 5	Musicality 1 2 3 4 5	Overall confidence 1 2 3 4 5
1 = least; 5 = most		

Test No.2: Suggestion-Response

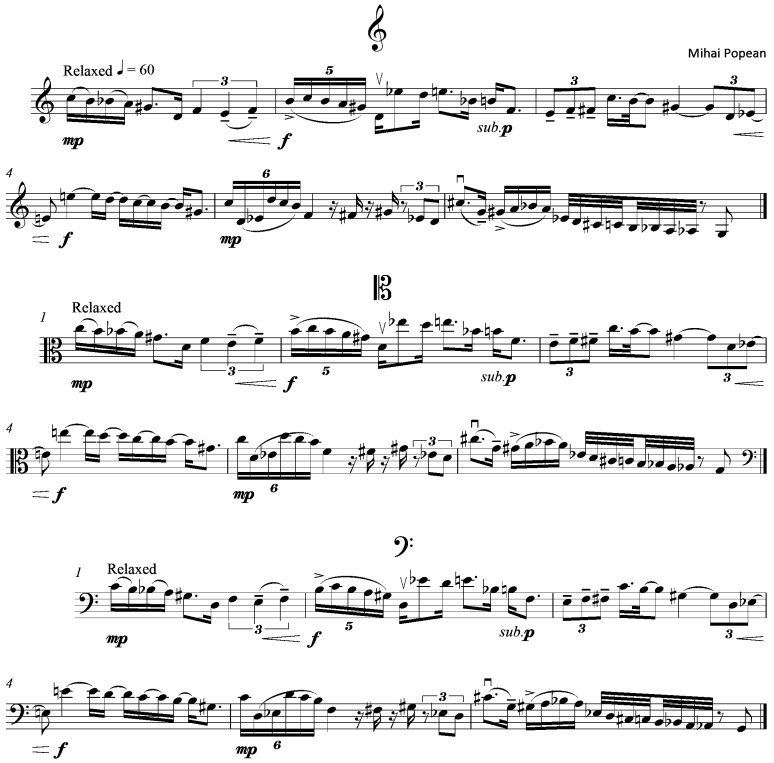
0 • • • 1 • • • 2
0 not at all; 1 mildly; 2 fully

Relaxation technique session: Yes ☐ No☐

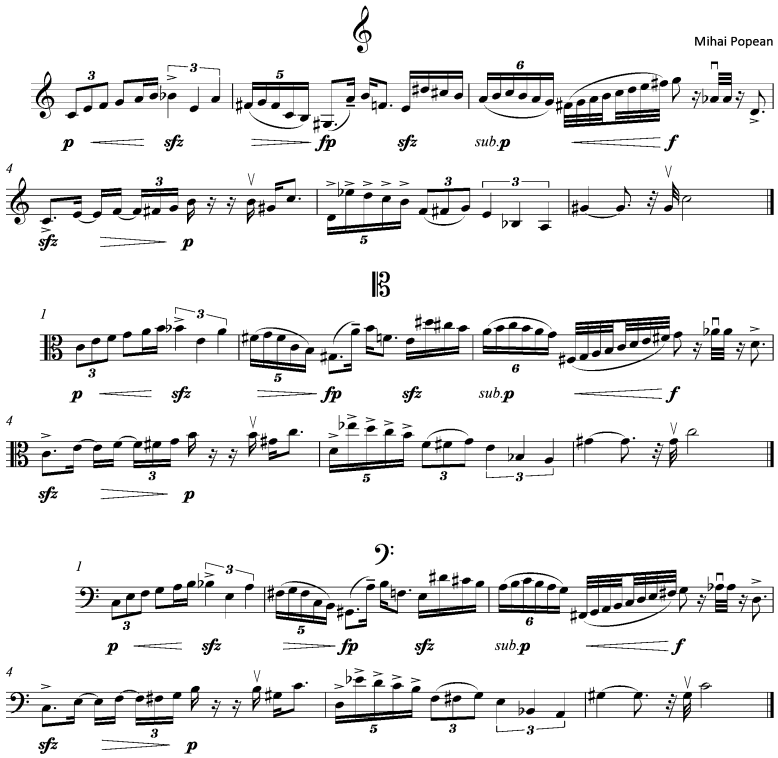
Test No.3: Sight-reading/short-term retention test

Rhythm 1 2 3 4 5	Pitch 1 2 3 4 5	Dynamics 1 2 3 4 5
Articulations 1 2 3 4 5	Musicality 1 2 3 4 5	Overall confidence 1 2 3 4 5
1 = least; 5 = most		

Appendix 2. Sight-Reading Test and Sight-Reading/Short-Term Retention Test



a. Sight-Reading Test



b. Sight-Reading / Short-Term Retention Test