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PROCEEDINGS

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Perception of Rhythmic Patterns, Meter, and Measure among Music Students

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Abstract

Rhythm represents a dynamic force that enables music communication when a cognitive, emotional, and aesthetic experience arises (Radoš, 2010). We rely on a theoretical conception of authors who believe that metric and rhythmic grouping are hierarchically organized (Lerdahl & Jackendoff, 1996). This research aims to determine: 1. the accuracy of observation of meter and rhythmic patterns within tasks of different duration; 2. whether the accuracy of the meter and rhythmic pattern recognition is related to the duration of the pattern; 3. how the previously acquired knowledge and experience correlate with the perception of rhythmic patterns. The questionnaire has three parts, where the third part includes 12 sound examples. The sound examples differ in their length (2, 4, 6, and 8 measures), meter, and the type of measure. The respondents had the task to determine the meter and the measure and then to write down rhythmic patterns. This research showed that when the number of measures within the patterns progressively increases, the accuracy of the measure perception is more likely. Accuracy of rhythmic pattern perception was considerably higher in the units of two and eight measures, while significantly less at the level of four and six measures. 81.6% of the respondents answered that during the observation of rhythmic patterns, they parallelly followed the rhythm and the melody, while 11.5% answered that they followed only the rhythm. The results indicate that the accuracy of measure and rhythmic pattern perception was significantly higher at the level of longer units. This finding suggests that the decision was based on the perception of relations in larger patterns. A better result on larger patterns suggests that music memory is better at the level of longer units, which is contrary to the initial expectations. During the perception of rhythmic patterns, the majority of respondents rely on the melodic component.

Introduction

Given that music is played over time, the primary function of the rhythm is to introduce organizational temporal patterns among the lower tones and to provide the kind of "stimulative" organization that will be understandable to the listener. If such an organization does not exist, the sounds that listeners hear will not be perceived as music (Radoš, 2010: 157).

Historically, understandings of the nature of musical abilities have evolved mainly in two directions: the Essentialist – who views musical ability as the sum of largely independent, most often sensory qualities, and the Unitarian – who speaks of a general aptitude. In Carl Seashore's view, musical ability is a set of loosely coupled basic sensory discrimination skills (experience of height pitch, volume, duration and timbre, rhythm and tonal memory) that have a genetic basis and do not change over time (Bogunović, 2010: 76). On the other hand, according to Herbert Wing, musical intelligence is a general ability to perceive and evaluate that occurs in two basic ways: as a musical ability in the narrow sense, that is, auditory sensitivity (distinguishing intervals, number of tones in a chord, memorizing tone and rhythmic patterns, noticing tonal modulation) and the ability to evaluate music aesthetically (to evaluate the adequacy of performing musical pieces in terms of rhythmic accentuation, harmonization of melody, dynamic nuance, phrasing) (Wing, 1971, as cited in Bogunović, 2010: 76).

In the psychology of music, rhythm has been explored less comprehensively than the tone's pitch. Interest in this aspect of music aroused in the nineteenth century and grew into a scientific consideration of a wider scope only in the 1950s. The role of rhythm in the percep-

tion of music is discussed by many authors and considered to be basic in music. Authors such as Jay Dowling and Dane Harwood found that rhythm is more important for musical cognition – perceiving, learning, remembering, and understanding music – than pitch information (Radoš, 2010: 156).

The temporal organization factor is essential for achieving and disrupting continuity. Differences must first be drawn between the pulse, the meter, and the rhythm. The perception of the pulse involves the objective or subjective division of time into the proper appearance of equally stressed pulses. Although a sense of pulse is required to give the impression of a meter, and although it is universally present in the rhythm perception, the pulse can exist and indeed exists, without meter or rhythm. On the other hand, the observation of a meter involves an awareness of the proper occurrences of stressed and unstressed beats. A necessary condition for a metric organization is to differentiate the beats into accent and non-accent beats. The perception of rhythm encompasses one or more unstressed beats concerning the stressed beat. These groupings may be more or less clear, and within any meter, they may vary indefinitely. The basic difference between the pulse, on the one hand, and metro-rhythmic plane, on the other, is that these other modes of a cognitive organization include distinguishing beat into stressed and unstressed, and the first not (Mejer, 1986: 144–146).

Authors Lerdahl and Jackendoff (1977) consider rhythmic grouping to be the most basic component of musical understanding. Rhythmic groups, as well as metric ones, are hierarchically organized: surface structures are subdivided into larger, depth assemblies, which are realized at a deeper, more abstract level and are based on combinations of duration structures, as well as melodic, harmonic, textural and non-musical data (Lerdahl & Jackendoff, 1977: 116).

These authors (Lerdahl & Jackendoff, 1996) also consider a metric structure, which is independent of the group structure. With proper musical cues, the listener will instinctively infer the correct, hierarchical beat pattern to which he relates the actual musical sounds. Without regularity, there can be no metric structure, and therefore the metric structure is a relatively local phenomenon. The rhythmic complexity of tonal music results from the interaction of metric structure with the structure of groups and the structure of tones pitch (Lerdahl & Jackendoff, 1996: 68).

The subject of the research is the perception of rhythmic patterns at the level of two, four, six, and eight-measure units and a determination of the meter and type of a measure. Nevertheless, one of the aims is allowing indirect conclusions about music memory and whether and to what extent, the accuracy of recognizing rhythmic patterns is related to previously acquired knowledge and experience.

Aims

1. to determine the accuracy of perception of the rhythmic patterns within a smaller units (two measures) and then larger units (four, six and eight measures); to determine whether the accuracy of recognition of rhythmic patterns, meter, and type of measure is higher at the level of shorter or longer units, or whether it is related to the length of the patterns; to indirectly learn about the scope and capacity of music memory within the tasks of different length.

2. to determine whether the previous knowledge and experience are in a correlation with the perception of rhythmic patterns, meter, and type of measure.

3. to determine whether the respondents followed the melody when writing rhythmic patterns or whether they relied solely on the rhythmic component; see if there is a significant difference in the perception of rhythmic patterns, meter, and type of measure between the students of theoretical directions and performers.

Method

Sample

In this exploratory research, a suitable sample consisted of bachelor (79.8%), master (16.9%), and doctoral (3.4%) students of the Faculty of Music in Belgrade. The total num-

ber of respondents was 89, of which 31.5% were male, and 68.5% were female. The age of the respondents ranged from 18 to 35 years, with the highest number (68.6%) being between 21 and 23 years old. Because students from all departments of this Faculty were included, it is possible to notice a fairly uniform number of respondents of theoretical directions (musicology, ethnomusicology, music theory, music pedagogy) and composition with 51.7% and performers 48.2% (piano performers, strings, wind instruments, poly-instrumentalists, jazz performers, solo singers, conductors). Although the uniformity of respondents of theoretical directions and performers was noticeable, within the two groups, the highest percentage were students of music theory (22.5%) and piano department (22.5%).

Measuring Instrument and Variables

The measuring instrument in this research was a questionnaire (8 open-ended and closed-ended questions) and the sound test. The first part of the questionnaire (questions 1 to 4) was related to the general data of the respondents, which included gender, age, year of study, and study direction. The second part of the questionnaire (questions 5 to 8) that was related to educational variables contained questions about the previously acquired knowledge and experience. First, the respondents answered questions about the self-assessment of the efficiency of perception and reproduction of rhythm, which contained the offered answers (very bad, bad, good, very good, excellent) on a five-point Likert-type scale. Then they answered questions related to the results achieved, that is, the average grade in the course of studies so far in the Solfeggio course and in the Harmony course (for the respondents of theoretical directions) and the Music analysis course (for the performers).

Sound Test

The most important part of the test was the sound test, which came with 12 audio examples taken from the piano literature. These short examples from different compositions served as patterns for recognizing the rhythmic patterns, the meter, and the type of a measure. At the end of the questionnaire, an open-ended question was asked, *Did you follow the melody during perceiving and writing down of rhythmic patterns, or did you rely on the rhythmic component?*

Sound Material

Short segments from solo piano compositions belonging to different historical and stylistic epochs Baroque, Classicism, Romanticism, 20th Century (Folklore Expressionism) were used. In sound examples, the homophonic texture prevailed, and the examples differed in the length of a given whole (two, four, six, and eight measures) and the type of meter (double or triple) and measure (2/4 or 4/4, 3/4 (3/8), 6/8).

Data Processing

Quantitative and qualitative data processing, descriptive analysis, correlative data analysis, and One-way analysis of variance (One-Way ANOVA) were conducted. Statistical processing of data was performed in the computer program SPSS Statistics.

Results

Descriptive Analysis

As part of the closed-ended questionnaire, the respondents assessed their own ability to perceive and reproduce rhythm (Likert scale from 1 to 5). It can be seen from Table 1 that the highest percentage of respondents rated their ability as very good.

The results in Table 1 also show that, in general, all the respondents had a significantly better self-assessment of rhythm reproduction and a slightly lower rhythm perception skill. Data on average grades in the Solfeggio course (M = 9.31, SD = 0.78), the Harmony course for respondents of theoretical directions (M = 9.32, SD = 0.81) and the Music analysis course for the performers (M = 8.92, SD = 0.93) show that they are very high (maximum is 10). The frequency distribution indicates that as many as 40.5% of the respondents have the highest grade 10 in the Solfeggio, and the same percentage for the same grade in the Harmony among students

Table 1. Self-assessment of rhythm perception and reproduction.

Self-assessment	Very bad	Bad	Good	Very good	Excellent
Self-assessment of rhythm perception	/	1.1%	39.3%	42.7%	16.9%
Self-assessment of rhythm reproduction	/	/	22.5%	47.2%	30.3%

of theoretical directions. When it comes to the average grade for Music analysis of the performers, 26.2% of respondents have a grade 9, while 23.8% have a grade 10.

Accuracy of the Perception of the Rhythmic Pattern

During the perception of the rhythmic patterns, respondents were asked to determine the type of a measure and write the rhythmic patterns. The maximum of measures (regardless of their duration) was 6. When evaluating the results of this variable, a scale was formed in which 2 indicated correct, 1 indicated partially correct, and 0 indicated an incorrect answer. By looking at the results related to the type of measure perception, it can be seen that the values of arithmetic mean increased progressively as the length of the given patterns increased. As the expected maximum score in sound tasks was different, their arithmetic means were transformed to the Z scale. In this way, it was possible to compare achievements across examples of different lengths. Findings indicate that perception of the rhythmic units is significantly greater in two-measure (M = 1.32, SD = 1) and eight-measure units (M = 1.08, SD = 1), while significantly less at the level of four-measure (M = -9.23, SD = 1) and six measure (M = -3.47, SD = 1) units.

It could be concluded that the perception of the type of measure is more accurate with increasing the length of a given rhythmic pattern because the internal organization of recognition is larger. This finding coincides with the expectations. The perception of rhythmic units shows surprising results. Rhythmic units are better recognized at the level of two-measure units because respondents perceive rhythm from unit to unit. Nevertheless, the results show that it is better to perceive at the level of eight-measure units, which can be conditioned by the repetition of the same rhythmic units within those longer units. By calculating the statistical significance of the differences between the arithmetic means, the idea was to establish a statistical confirmation of the obvious differences in the accuracy of the type of measure observations when increasing the given sound examples.

The results indicate that there is a statistically significant difference between achievements in the perception of the type of measure (Table 2).

By comparing the arithmetic means all of the patterns of different duration, it is shown that the accuracy of perceiving the type of measure is higher as the length of the given patterns

Table 2. Significance of difference in the accuracy of the perception of the type of measure.

Perception of the type of measure								
Two-measure units		Four-measure units		Six-measure units		Eight-measure units		
M	SD	M	SD	M	SD	M	SD	*t*
3.18	1.93	3.65	1.82					$t(88) = -2.08, p = .02$
3.18	1.93			4.08	1.60			$t(88) = -4.15, p < .001$
3.18	1.93					4.55	1.50	$t(88) = -7.19, p < .001$

increases progressively. This is (somewhat) expected because, by the nature of things, it is easier to determine the type of measure in a longer-lasting sound task.

Correlation of the Previously Acquired Knowledge and Experience with the Perception of the Rhythmic Patterns

Correlations between the self-reported evaluation of rhythm perception and reproduction, and the accuracy of rhythmic pattern perceptions, that is, type of measure and rhythmic units, were not statistically significant in this research. But there are some correlations between the achievement of a sound test and academic achievement. A statistically significant correlation was found between the average grade in the Solfeggio course and the perceptions of rhythmic units in four ($r = 0.34$, $p < .01$), six ($r = .38$, $p < .001$) and eight-measure ($r = .28$, $p = .008$), and in total ($r = .37$, $p < .001$). When all sound tasks were taken into account together, there was a significant correlation between the type of measure perceptions and the average grade achieved in the Harmony course ($r = .37$, $p < .001$).These results indicate that solely grades in the Solfeggio course are related to the perception of rhythmic units in sound tasks, whereas grades achieved in the Harmony and Music analysis courses do not correlate with the same results. However, the average grade in the Harmony course correlates with the perception of the type of measure, regardless of the duration of given rhythmic patterns. Perceiving the type of measure and rhythmic patterns is a skill acquired through theoretical and practical work, and these results indicate that the Solfeggio classes have positive results on this skill among music students. There is no significant correlation with subjects that imply an understanding of the harmonic processes and musical structures within larger entities. These subjects require cognitive insight into a greater whole and hierarchical structures and have no implications on acquiring the skill of perceiving and writing down rhythmic patterns.

Focusing on Certain Components of Musical Expression During the Perception of Sound Examples

During the perception of rhythmic patterns, 81.6% of the respondents said that they parallelly followed the rhythm and melody, while 11.5% said that they only followed the rhythm. 6.9% of the respondents wrote that they relied only partly on the rhythmic component and partly on both components together during the writing. A one-way analysis of variance (One-way ANOVA) was used to determine whether there was a difference between the perception of the type of measure and parallel following the rhythm and/or melody. The results indicate that when it comes to smaller patterns (two-measure), respondents decide the type of measure based on following the rhythm and melody at the same time (Table 3).

Table 3. Significance of differences in the perception of the type of measure and the rhythm and/or melody.

Measure	Only Rhythm			Rhythm + Melody (partially)			Rhythm + Melody			ANOVA
	M	SD	N	M	SD	N	M	SD	N	
Two measure units	2.10	2.02	10	2.00	1.27	6	3.43	1.92	71	$F(2.86) = 3.43$, $p = .037$
Four measure units	2.40	1.90	10	2.83	2.86	6	3.97	1.59	71	$F(2.86) = 4.45$, $p = .014$
Six measures units	3.80	2.48	10	3.33	1.86	6	4.22	1.35	71	$F(2.86) = 1.15$, $p = .321$
Eight measure units	4.20	1.93	10	3.33	1.97	6	4.77	1.24	71	$F(2.86) = 3.49$, $p = .035$

During the perception of larger patterns, according to the existing results, the following of rhythm and melody is not statistically significant. By calculating the statistical significance of the differences between the rhythmic unit perceptions and parallel following the rhythm and/or melody, it was found that there were no significant differences. It can be assumed that during the perception of larger patterns, respondents include other components of musical expression or cognitive-organizational principles. One-way ANOVA was also used to see if there was a difference in the perception of the type of measure and rhythmic patterns according to the study direction (theoretical or performers) by the respondents. The results in Table 4 show that there is statistical significance in the perception of the type of measure in two, four and eight measure patterns in favor of the students of theoretical directions. At the level of perception of the type of measure in six measure patterns and belonging to different directions, it does not prove to be statistically significant. By calculating the statistical significance of differences between perceptions of rhythmic units and belonging to theoretical directions or performers, it was found that there were no significant differences.

On the other hand, the perception of rhythmic units gives unexpected results. Music students perceived the best rhythmic units within the smallest patterns. This may indicate that the cognitive ability of the respondents functioned in a "small space" (two measures) as they observed from one rhythmic unit to the other. This result may also be related to the Solfeggio practice, as mentioned earlier, which implies that after playing the whole dictation, the phrase of two measures is played. Respondents also perceive well the rhythmic units within the longest patterns (eight-measure). It can be concluded that the scope and capacities of music memory of the respondents were significantly developed. However, good perception at the level of eight-measure patterns can indirectly be influenced by the repetition of the same rhythmic units within those patterns.

Table 4. Perceptions of measure with students of theoretical directions and performers.

Measure	Theoretical directions			Performers			ANOVA
	M	SD	N	M	SD	N	
Two measure units	3.65	1.80	46	2.67	1.96	43	$F(1.87) = 6.00$, $p = .016$
Four measure units	4.02	1.62	46	3.25	1.96	43	$F(1.87) = 4.03$, $p = .048$
Six measure units	4.34	1.33	46	3.80	1.80	43	$F(1.87) = 2.79$ (1), $p = .099$
Eight measure units	4.91	1.02	46	4.16	1.80	43	$F(1.87) = 5.93$, $p = .017$

Conclusions

The results indicate that the perception of the meter, the type of measure, and rhythmic patterns vary depending on the length of the sound example. When perceiving the meter and the type of measure, the respondents' results progressively increase as the length of the given rhythmic patterns increases (from two to eight measures). This finding coincides with the expected outcomes, as meter and type of measure are significantly easier to detect over longer patterns. Also, this may be related to the fact that usually, with a melodic-rhythmic dictation task, students first listen to it as a whole (of eight or more measures) so they could determine the meter and type of measure, and then it is played in the phrases of two measures.

On the self-evaluation scale of rhythm perception and reproduction, the majority of respondents rated these abilities as very good

(slightly higher for reproduction than for rhythm perception). This may be related to Solfeggio grades, where a significant number of respondents (as much as 40.5%) have the highest grade (10). The results of the research indicate that there is a significant correlation between students' academic achievement, that is, the average grade in the Solfeggio course and perception of rhythmic units at the level of four-measure patterns and above. Whereas, there is a significant correlation between the average grade achieved in the Harmony course and the type of measure, no matter how long the rhythmic pattern is. The average grade achieved in the Music Analysis course (with the performers) did not prove to be statistically significant. From this, it can be concluded that conducting theoretical and practical work in the Solfeggio course (but also to some extent in the Harmony course) has positive and significant results in developing the skill of perception the rhythmic patterns, meters and type of measure at music students.

When perceiving and noting the rhythmic patterns, the majority of respondents stated that they parallelly followed the rhythmic and melodic components. By adjusting the variables of perceptions of rhythmic patterns, meter, and type of measure with rhythm and/or melody parallel following, the results obtained indicate that the respondents made perceptions of the type of measure in two-measure patterns based on the parallel following of rhythm and melody. At the level of larger patterns than two measures, the statistical significance of the results between the perception of rhythmic patterns, meter and type of measure, and following of rhythm and/or melody together was not shown. The assumption is that when perceiving the larger patterns, respondents include other musical components and cognitive-organizational principles. By adjusting the variables belonging to theoretical directions or performers and perceptions of rhythmic patterns, meters, and type of measure, the perception of the type of measure in two, four, and eight-measure patterns proved to be statistically significant, more in theoretical directions than in performers. These findings may be directly related to the fact that the students of theoretical directions, according to the study curricula, attend quantitatively more lectures in the Solfeggio course, and therefore have much more practical experience in perception than the performers.

The results of this research indicate that various factors may influence the perception of rhythmic patterns. The length of given patterns depends on how well music students perceived the rhythmic patterns, the meter, and the type of measure. The important thing is the development of music memory. This research confirmed that high academic achievement (grades in the Solfeggio and Harmony courses) and self-assessment skills correlated with success in the perception of the rhythmic patterns. It has also been found that during the perception, music students find it difficult to separate the rhythmic from the melodic component, which is influenced by other components of the musical expression. All these findings can serve as a starting point for some new empirical research in the field of rhythm perception in music.

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