PERCEPTION OF SYMMETRIC AND ASYMMETRIC METERS BY LISTENERS FAMILIAR AND UNFAMILIAR WITH ASYMMETRIC METERS

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ABSTRACT

Models of rhythm perception typically make reference to hierarchical frameworks in which time is divided into intervals nested in each other. In these hierarchical structures, it is required or preferred that time intervals at the same level are of equal durations and durations of intervals in neighboring levels are related by simple integer ratios. Both of these rules or preferences are violated in asymmetric meters that are used commonly in the music of certain geographic areas. The aim of the present study was to determine whether listeners familiar with musical idioms that frequently use asymmetric meters have schematic representations for such asymmetric meters or perceive such meters by trying to fit them into symmetrical metric frameworks. Results did not provide support for the existence of schematic representations of asymmetric meters.

1. INTRODUCTION

An assumption that is frequently made in theories of how melodies or temporal structures are perceived and remembered is that a part of this process relies on schematic representations that make use of equal time spans. The dynamic attending theory of M. R. Jones (1976; Jones & Boltz, 1989) and the metric structure in the Generative Theory of Tonal Music by Lerdahl and Jackendoff (1983) are the best known theories that incorporate this idea. In these theories, time is divided into spans of equal duration at hierarchical levels marked by accents of different strengths. A similar idea is also the point of departure for clock models in which accents separated by equal time intervals activate mental clocks that make up a framework for perception of auditory sequences (Essens & Povel, 1985; Povel, 1981; Povel & Essens, 1985).

Although better performance with regular compared to irregular metric structure has been observed in a number of tasks (Boltz & Jones, 1986; Essens, 1986; Hébert & Cuddy, 2002; Jones & Yee, 1997; Large & Jones, 1999; Yee, Holleran, & Jones, 1994), asymmetric meters (more commonly known as Bulgarian rhythms) that include unequally timed accents at one level of the hierarchy as well as alternative representations that can accommodate such meters have recently enjoyed increasing attention (Large & Jones, 2002; London, 1995, 2000; Magill & Pressing, 1997). Our aim in the experiment reported here was to compare the performance of a sample of participants who were exposed to a musical idiom that made frequent use of asymmetric meters (Turkish folk music) with that of a sample of participants who were expected to have severely limited exposure to asymmetric meters.

The two samples were selected from among university students in Turkey and in the United States of America. Participants were given a discrimination task in which they had to decide whether two melodies they heard in close succession were identical or had different meters. The melodies were the same in all other respects. The logic behind the experimental procedure was based on the observation that if two test stimuli differed in such a way that one conformed to an overlearned schematic structure and the other violated it, detection of the difference would be easier if the schematic stimulus was presented as the standard and the deviant stimulus was presented as the comparison (e. g., Bharucha & Pryor, 1986, in the domain of rhythmic perception).

We used a total of six types of trials. In two of them, the same melody was presented twice, with one involving the presentation of melodies with symmetric meters and the other involving the presentation of melodies with asymmetric meters. These trials required a “same” response. In the remaining four types of trials, two different versions of the same melody were presented. The four types of pairs of melodies presented in these trials comprised symmetric-asymmetric, symmetric-irregular, asymmetric-symmetric, and asymmetric-irregular meters. In the melodies with irregular meters the meter changed from one measure to the next. These trials required a “different” response.

The predictions were as follows: If mental representations of temporal organization could accommodate only melodies with symmetric meters, then performance on the “same” trials with symmetric meters should be higher than performance on the “same” trials with asymmetric meters. If both types of meters could be mentally represented with equal ease, on the other hand, performance on the two types of “same” trials should be comparable. As for the “different” trials, on the assumption that only symmetric meters fit existing mental representations, performance on symmetric-asymmetric pairs should be better than performance on asymmetric-symmetric pairs; performance on asymmetric-symmetric pairs should be better than

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performance on the asymmetric-irregular pairs; performance on symmetric-irregular pairs should be better than performance on the asymmetric-irregular pairs; and performance on symmetric-asymmetric and symmetric-irregular pairs should be comparable. On the assumption that people can accommodate representations of both symmetric and asymmetric meters with similar ease on the other hand, performance on symmetric-irregular pairs should be better than performance on symmetric-asymmetric pairs; performance on asymmetric-irregular pairs should be better than performance on asymmetric-symmetric pairs; performance on symmetric-asymmetric pairs and asymmetric-symmetric pairs should be comparable; and performance on symmetric-irregular and asymmetric-irregular pairs should be comparable. We expected that the Turkish sample would be able to process melodies with asymmetric meters as easily as those with symmetric meters, whereas the American sample would behave as if their representations were specialized for symmetric meters only.

2. METHOD

2.1. Participants

Participants were 112 undergraduates of Middle East Technical University in Ankara, Turkey and 112 undergraduates of American University, Washington DC, USA. The average number of years of formal musical training was 0.07 for the Turkish sample and 4 years for the American sample.

2.2. Stimuli

The stimuli were based on 16 melodies from Turkish folk music. Eight of these melodies had symmetric meters and eight had asymmetric meters in their original forms. All melodies were made 20 bars long by eliminating the remaining bars of the longer melodies and altering the final bar in the resulting excerpt. These original melodies were transformed further to create two more versions of each melody. The second versions of the symmetric melodies had asymmetric meters and those of the asymmetric melodies had symmetric meters. The third versions of the melodies did not have regular meters. Rather, meter changed in each bar of these melodies. In order to create these new versions of the melodies the durations of 10 notes on average were altered. The melodies were recorded on tape by playing them in the MIDI piano timbre with equal velocities for all notes in a melody.

2.3. Design

Participants in each sample were divided into eight groups. All participants listened to 16 experimental trials containing repetition of a single version or two different versions of the 16 melodies. For each participant eight melodies were presented in "same" trials and eight melodies were presented in "different" trials. The eight "same" trials were equally divided among presentations of original symmetric melodies, symmetric versions of originally asymmetric melodies, original asymmetric melodies, and asymmetric versions of originally symmetric melodies. The eight "different" trials were equally divided among the four types of pairs to be presented (symmetric-asymmetric, symmetric-irregular, asymmetric-symmetric, and asymmetric-irregular). Of the two tokens of each type of pair, one was based on an originally symmetric melody and the other was based on an originally asymmetric melody.

Across the eight groups, each melody appeared equally frequently in all types of the "same" trials and equally frequently in all types of the "different" trials. Because the number of types of "same" and "different" trials were unequal, however, each melody was heard in each type of "same" trial twice as many times as it appeared in each type of "different" trial.

2.2. Procedure

Participants listened to tape recordings of the pairs through loudspeakers. Each tape contained 16 experimental trials as described above. Each trial consisted of repetition of the same version or presentation of two different versions of a melody. Pairs in a trial were separated by 5 seconds of silence and pairs were separated from each other by 10 seconds of silence. Participants were asked to mark their answers on answer sheets that were distributed to them. Answer sheets contained the response alternatives "same" and "different" for each pair number.

Instructions informed the participants that they would hear pairs of melodies, sometimes the melodies in a pair would be identical and sometimes they would be different, and they were asked to mark whether they thought the two presentations in each pair were the same or different on the answer sheet. Participants were presented with examples of "same" and "different" trials before the start of the experimental task.

3. RESULTS

The average numbers of correct responses to each type of pair was calculated for each participant. Pairs based on originally symmetric melodies and originally asymmetric melodies were treated separately. As a result of this, two responses to each type of "same" trial and one response to each type of "different" trial were obtained. These average percentages of correct responses are presented in Table 1. In all the following Analyses of Variance (ANOVA) type of pair and original meter of melody were within-participants variables and population (Turkey versus USA) was a between-participants variable.

3.1. Comparison of Symmetric-Symmetric and Asymmetric-Asymmetric Pairs

In the analysis of the responses to the "same" trials, the main effect of the original meter was marginally significant [$F(1, 222) = 3.89$, $p = .05$] but this effect interacted with type of pair [$F(1, 222) = 13.05$, $p < .001$]. There were no other significant effects. Participants were more likely to give "same" responses to the symmetric-symmetric pairs compared to the asymmetric-asymmetric pairs for the originally symmetric melodies only. Making comparisons was easier for the original versions of the melodies, especially for the symmetric meters. The Turkish and American samples did not differ significantly.

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3.2. Comparison of Symmetric-Asymmetric and Asymmetric-Symmetric Pairs

In the analysis of the responses to the "different" trials in which the symmetric and asymmetric versions of a melody were presented in the two possible orders, the interaction of type of pair and original meter was significant [$F(1, 222) = 20.62$, $p < .001$].This interaction was due to better discrimination of symmetric-asymmetric pairs for the originally symmetric melodies and better discrimination of asymmetric-symmetric pairs for the originally asymmetric melodies. It appeared that discrimination was easier if the original version of the melody was heard before the experimentally altered version compared to the reverse order. Participant population entered a significant interaction in this case: The effects of population and original meter interacted [$F(1, 222) = 4.26$, $p < .05$]. American participants were more likely to give "different" responses if the original meter of the melody was asymmetric. This was mainly because American participants had difficulty discriminating the two versions in the asymmetric-symmetric pairs. However, the three-way interaction was not significant [$F(1, 222) = 1.21$].

Type of pair and original meter	Turkey	USA
Symmetric-Symmetric		
Symmetric original	76	68
Asymmetric original	58	60
Asymmetric-Asymmetric		
Symmetric original	62	58
Asymmetric original	64	64
Symmetric-Asymmetric		
Symmetric original	77	75
Asymmetric original	61	64
Asymmetric-Symmetric		
Symmetric original	72	54
Asymmetric original	79	80
Symmetric-Irregular		
Symmetric original	84	64
Asymmetric original	72	62
Asymmetric-Irregular		
Symmetric original	58	54
Asymmetric original	79	67

Table 1. Percentages of correct responses to the types of "same" and "different" pairs by the Turkish and American participants.

3.3. Comparison of Symmetric-Asymmetric and Symmetric-Irregular Pairs

In the analysis of the "different" trials in which the symmetric version of the melodies were followed by either the asymmetric or the irregular version, the main effect of original meter was significant [$F(1, 222) = 10.96$, $p < .001$]: Performance was better for originally symmetric melodies. This was again consistent with discriminating better if the original version of the melody was presented first in a pair. However, there was also a main effect of participant population [$F(1, 222) = 4.79$, $p < .05$] that interacted with the effect of type of pair [$F(1, 222) = 7.39$, $p < .01$]. Turkish participants discriminated the symmetric-irregular pairs better, but the difference was in favor of the symmetric-asymmetric pairs for the American participants.

3.4. Comparison of Asymmetric-Symmetric and Asymmetric-Irregular Pairs

In the analysis of the "different" trials in which the asymmetric version of the melodies were followed by either the symmetric or the irregular version, there was a main effect of type of pair [$F(1, 222) = 4.94$, $p < .05$]. Performance was higher on the asymmetric-symmetric pairs than the asymmetric-irregular pairs. The main effect of original meter was also significant [$F(1, 222) = 30.72$, $p < .001$]. Discrimination was better with originally asymmetric melodies, which again demonstrated that presenting the original version first in a pair facilitated performance. The main effect of participant population [$F(1, 222) = 7.38$, $p < .01$] showed better performance of Turkish compared to American participants. The three-way interaction was also significant [$F(1, 222) = 4.8$, $p < .05$]. This was because discriminating the asymmetric-symmetric pairs was easier for the originally symmetric melodies for the Turkish participants but for the originally asymmetric melodies for the American participants was easier.

3.5. Comparison of Symmetric-Irregular and Asymmetric-Irregular Pairs

Although the main effects of type of pair [$F(1, 222) = 3.54$, $p < .061$] and original meter [$F(1, 222) = 3.38$, $p < .067$] missed reaching statistical significance, the interaction of these effects was significant [$F(1, 222) = 16.65$, $p < .001$] in this analysis. This was due to better discrimination of asymmetric-irregular pairs for the originally symmetric melodies and the symmetric-irregular pairs for the originally asymmetric melodies. This result went against the general inclination for better discrimination if the original of a melody was presented first. In addition, Turkish participants performed better than American participants [$F(1, 222) = 12.22$, $p < .001$].

4. DISCUSSION

The results generally did not support the hypothesis that Turkish listeners processed melodies with asymmetric meters more easily compared to the American listeners. The only finding to support this idea was that Turkish participants performed better on the symmetric-irregular pairs compared to the symmetric-asymmetric pairs whereas the difference was in the opposite direction for the American participants.

In support of the idea that there is a superiority of processing melodies with symmetric meters, the comparison of the asymmetric-symmetric and asymmetric-irregular pairs showed that the asymmetric-symmetric pairs were easier for both populations. This difference should have been in the opposite direction, however, if melodies with asymmetric meters could be mentally represented as easily as those with symmetric meters. On the other hand, some of the differences predicted by the privileged processing of symmetric meters were not observed. One of these was better performance on the symmetric-irregular pairs

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compared to symmetric-asymmetric pairs, which did not reach conventional levels of statistical significance. The difference between the symmetric-symmetric pairs and the asymmetric-asymmetric pairs was still more distant to significance and the numerical difference between the symmetric-asymmetric and the asymmetric-symmetric pairs was in the opposite of the expected direction.

A more reliable effect emerged for findings that were based on the original meter of the melodies. Typically if the original version of a melody was presented first in a pair, discrimination was better compared to the reverse order of presentation. This implied that the experimentally created versions of the melodies were less natural than the original versions. This was a difference that both populations could make use of. The asymmetric-irregular pairs based on originally symmetric melodies, which did not include any melody with a symmetric meter or the original version of the melody, were most difficult for both groups.

The results provide preliminary support for more efficient processing of melodies with symmetric compared to asymmetric meters, even by listeners who are familiar with idioms that frequently make use of asymmetric meters. We intend to follow up on these findings with better controlled stimuli that may reveal effects related to meter of the presented versions rather than the original versions of melodies.

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