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The Role of Repetition in Aural Identification of Harmonic Sequences

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Abstract

The aim of the study was to investigate further the role of stimulus repetition during the on line processing of aural identification of harmonic sequences. This process involves (a) building a mental representation; (b) relating it to the knowledge base available in the long-term memory system; (c) selecting the correct label, and (d) writing the label without interrupting continuous listening. The time span between chords is decisive in this mechanism. Nine sequences containing eight harmonic functions of I, IV, and V degrees were presented three times each. Subjects (N=72 undergraduate students) had to listen to each presentation and write down the label of each chord with Roman numerals while listening. Findings show that the first presentation is a powerful image that influences the subsequent identifications. Repetition favours the identification of those chords which had been omitted in the previous listening. Once the image has been shaped as a percept it will be difficult to change it. When the response is incorrect, repetition was found to operate in a paradoxical way by imprinting the error. Many of the common practices in the context of the music class are based on repetition. Findings show that repetition per se does not provide a basis for the improvement of performance.

Introduction

The development of the ability to identify and label harmonic functions is part of the ear training of courses for professional musicians. This development requires the use of cognitive strategies of variable complexity. The mechanism involves (a) processing the input and building a mental representation, (b) relating this representation to the knowledge base available in long-term memory system, (c) selecting the correct label, (d) writing the label without interrupting the continuous listening of the musical stream of information. When the time span between chords is less than one second, the *time* needed to perform this chain of operations is decisive. Teachers have a tendency to manage the students' difficulties by presenting the same stimulus several times.

According to Povel and Egmond (1993), musical listening is an online process that has two stages: (a) a dynamic circuit between the input and the knowledge base is activated and (b) as a consequence, a mental representation is built.

In tonal music the knowledge base is built according to the rules of the tonal system. Some models have been derived: (a) psychological models that conceive the tonal space as a virtual space that operates as a powerful cognitive map of the multiple relationships between tones (Brown, Butler, & Jones, 1994) and (b) theoretical models that can be explained in terms of the triads of I, IV, and V; the degrees of the scale whose sound components complete the major scale (Platt & Racine,1994; Schenker,1954). Both approaches share *the hierarchical nature of the tonal system,* with relationships between elements at different levels and *the assignment of the relative position of their elements* related to the tonic.

How are harmonic aspects activated while listening to music? Some studies (Bharucha, 1984; Deutsch, 1984; Butler, 1992) report that some components, such as the order of occurrence of the chords, the characteristic sounds, and the metrical organisation, may take part in the building of the mental representation of the harmonic image.

Listening to a harmonic sequence involves the processing of each chord, which is understood both as a local goal and as a part of the chain. The diachronic nature of this process may create expectations about the following incoming chord information. Expectations are supposed to be based on the internal building of the sequence, in which the order of occurrence of chords, the vocal leading and the metrical stress are the main indicators. These features are variables in the process of identifying and labelling each chord.

The particular relationships between chords in a given sequence generates the perceptual configuration of a tonal centre. This concept has been named *tonal clarity* (Croonen & Kop, 1989). There are strong and weak sequences in terms of tonal clarity. A paradigmatic strong sequence would be IV, V, and I. Strong sequences would be easier to memorise than weak sequences.

The speed of the succession is another variable that needs to be taken into consideration. At first, the listener forms an idea of the tonal centre as a hypothesis. Listeners are biased to assume that the first tone in a musical event is the tonal center, until a better candidate replaces it as listening progresses (Brown, Butler, & Jones, 1994). The time span available to process the incoming information gives better opportunities for assigning meaning to it. Studies on melodic cognition show that it is possible, in short-term tasks, to use the interval information in very short periods of time such as one second (Croonen & Kop, 1989; Croonen, 1995). The interval information may be involved in the process of identification of harmonic functions allowing the comparison between the roots of the successive chords and the tonic. It is probable that the access to interval information depends on the availability of repetitive listening of the musical sequence. According to Croonen (1995) repetitive listening helps to gather the interval information of a tonally strong series but does not help in the case of a tonally weak series. Repetition acts in two ways: (a)allowing the *familiarity* with the stimulus and (b) increasing the time available to accomplish the processing of the chord information. However, familiarity with the stimulus is not clearly the only reason to recognise a given sequence better than another one (Croonen, 1995).

The idea of *familiarity* has been applied to the study of basic procedures to identify conceptual categories (Pollard-Gott, 1983). To do so, the listeners need to be exposed to the stimulus on several occasions. In this process, repetitive listening turns into learning, because it implies the acquisition of concepts in a cumulative way. It would be interesting to know if, once the category has been attributed, an opportunity for further listening would modify the previous identification. The aim of the present study was to further investigate the role of stimulus repetition during on line aural identification of harmonic sequences.

Method

Subjects

Participants were 72 adult beginners: students belonging to the Introductory Music Course at Universidad Nacional de La Plata (mean = 20 years old). Subjects had passed a standard aural skills test of ear training that involved: (a) diatonic melodies by steps and intervals from tonic to dominant notes, (b) tonic and dominant harmonic functions in root position and inversions, (c) sight reading of tonal melodies by steps, (d) series of diatonic intervals, and (e) binary and ternary rhythms of melodies.

The following apparatus was used: Cake Walk 2.0 Sequencer; MIDI connection with Proteus FX and Marantz S.D. 1000 audio cassette recorder.

Stimuli

Nine sequences of eight harmonic functions (I, IV, and V degrees) were composed. Timbre used was Grand Piano. Tempo was 70 bpm. Each stimulus was presented three times in three consecutive trials. The first trial was preceded by a tonal cadence (IV–V–I). The sequence began after 2.88 sec. The time span between each trial was 15 sec.

Procedures

Subjects listened to the nine sequences in three successive trials, and to write down the label of each chord using Roman numerals. The order of the series was randomly arranged. They were asked to write when they were sure of the response; if they were not, they were instructed to leave the spaces blank until the following trial. The time between trials could be used to complete the responses.

Results

The responses were classified in correct, incorrect, and blank. The data obtained from each presentation was compared. The variability of the responses to each category (correct, incorrect and blank) were measured according to the *rate of immediate increase in the number of responses* between the first and the second trial and the *rate of non immediate increase in the number of responses* between the first and the third trial (Table 1).

The tendency to stability or change in the responses along the successive trials was analysed according to the *rate of immediate permanence* (proportion of identical responses between the first and the second trial) and the *rate of non immediate permanence* (proportion of responses that were identical after the first and the second trial and which remained identical after the third one)(Figure 1).

Table 1
Rates of Increase in the Number of Responses
(Immediate and Non-immediate)

Categories of responses	*Number of responses*			*Rates of increase in the number of responses*	
	Trial 1	*Trial 2*	*Trial 3*	*Immediate*	*Non-immediate*
Correct	3254	3778	3994	16%	22%
Incorrect	852	959	1012	13%	19%
Blank	1078	447	178	–59%	–83%

Discussion

This study clarifies the role of repetition during on line aural identification of harmonic sequences. It also provides an explanation of the relative incidence of repetition in omitted and incorrect answers. Most of the answers were formed during the first presentation. According to Butler (1990), the tonic is the first tonal feature that the listener configures when he listens to a tonal sequence. In the present study, the tonic identification was favoured for the tonal cadence before the harmonic sequence begins. The time span between the tonal cadence and the harmonic sequence was of almost three seconds. During this lapse the subject could even internally rehearse the tonic previously configured (Croonen & Kop, 1989). The high level of correct answers to the first presentation would be explained by the features of this test.

Tonal clarity would be guaranteed since the sequences used only the I, IV and V degrees. For this reason, the series may be considered tonally strong. However, is any sequence containing these degrees equally clear? Characteristics of the series, such as the voice leading, the texture and the order of appearance of the different degrees among

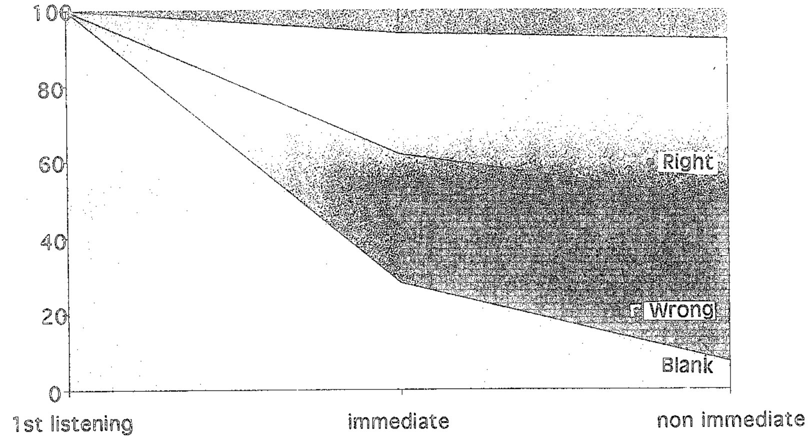

Figure 1. Rates of permanence.
Correct, $\chi^2 = 52$ $p < .001$
Blank, $\chi^2 = 7.16$ $p < .05$
Incorrect, $\chi^2 = 33.14$ $p < .001$
Note: This graph shows the total number of responses (9 sequences). The tendency for each sequence shows similar profiles.

other factors, may be valuable indicators in estimating the degree of tonal clarity of a given harmonic sequence.

As can be observed in Table 1, 20% of the responses could not be configured in the first listening and required a new presentation. The data shows that this new presentation provided the listener with another opportunity to shape the answers that had been omitted in the first listening. Although most of these new answers were correct, the second presentation did not guarantee the total correct solution of the task, since incorrect and blank responses remained. The number of correct and incorrect responses to the third presentation was similar.

Results show that the first presentation is a powerful *image* that influences the subsequent identifications. Repetition favours the identification of omitted chords in the previous listening. It would be possible to think that (a) subjects omit the answer because they were not able to shape a clear image of the object and (b) repetition gives a new opportunity to *familiarise* themselves with the stimulus, and also provides spare time to process the available information.

When responses to the first presentation are incorrect things are different. Once the image has been shaped as a percept it will be difficult to change it. In this case, repetition seems to operate in a paradoxical way by imprinting the incorrect answer. This statement has very strong implications for the field of music education because many of the common practices in the context of the music classroom are based on repetition. Findings show that, in this kind of task, repetition *per se* does not provide a basis for the improvement of incorrect responses.

Turning the incorrect *image* into a correct one would be the result of strategies that

allow the subject to re-process the incoming information in an immediate way. During this process the monitoring of the teacher and immediate feedback would avoid the imprinting of the error. Another implication for music education would be the development of ear training based on immediate response. In this case, it would be helpful to develop cognitive strategies that allow the teacher to monitor, while teaching, the reaction time of the student to process the stimulus. Future research might focus on the study of the immediate reactions of musicians who are able to successfully play harmonic accompaniments for singers.

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