THE INFLUENCE OF HARMONIC RELATIONS AND TEMPORAL REGULARITIES ON CHORD PROCESSING

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ABSTRACT

Music perception relies on processing both the tonal relations between pitches and the temporal regularities of their occurrence. Even non-musician listeners develop expectancies about "What" event is coming next and "When" it will occur. In three experiments, the two dimensions were systematically manipulated in eight-chord sequences. Two different tasks were used: a harmonic priming paradigm (Exp.1 & 2) and subjective judgments of completion (Exp.3). In Exp.1 & 2, both harmonic relations and temporal regularities influenced chord processing and in Exp.1 the two dimensions partially interacted. In Exp.3, harmonic relations and temporal regularities also influenced subjective judgments of completion, but no interaction between pitch and time was observed. The present study suggests that the influence of harmonic relations and temporal regularities in the perception of chord sequences differs from the perception of melodies for which the influence of tonal relations was altered by temporal regularities.

1. INTRODUCTION

Western tonal music is composed of two principal dimensions: harmonic relations between pitches and temporal regularities. Up to now, harmonic priming research has focused on expectations about the "What" of an event and studied their influence on chord processing: for musician and non musician listeners the processing of a target chord is facilitated when it has strong harmonic relations with the prime context (1, 2). Our present study was designed to analyze the influence of both harmonic relations and temporal regularities on chord processing and more specifically, whether they are articulated in interaction (3) or independently (4) (Exp.1 & 2). Exp.3 further investigated in how far their relative influences could vary for subjective judgments of completion requiring to evaluate a sequence as a whole.

2. EXPERIMENT 1

2.1. Method

Participants: twenty-five non-musician students.

Material & Procedure: Eight-chord sequences based on material of (2) were used. The first seven chords defined the context and the last one, the target. The target was harmonically related (it functioned as a tonic chord) or less related (it functioned as a subdominant chord) to the prime context. The prime context was played regularly or irregularly. In regular sequences, the Stimulus Onset Asynchrony between two chords was kept constant (SOA= 640 ms) and each prime chord was played at the same time points for all regular sequences: t1= 0ms, t2= 640 ms, t3=

1280 ms... Irregular sequences were built on the basis of regular ones: chord 1 and chord 7 were played at the same time points as in regular sequences (t1, t7), and for chords 2 to 6 inter-chord-intervals were varied between 0 ms and 960 ms. Twelve different irregular sequences were constructed. The target was played (in regular and irregular sequences) either "on time" (t8=4480 ms), "earlier" (-240 ms) or "later" (+240 ms) than regular SOA, and it sounded for 2000 ms. The first seven chords were played 320 ms on followed by 320 ms off: sequences sounded "staccato" (i.e., chords are separated from each other by short silence). The prime context was played with an acoustic piano sound and the target with an acoustic guitar sound (timbre A) or a harp sound (timbre B). Participants were asked to perform a speeded accuracy timbre discrimination judgment on the target.
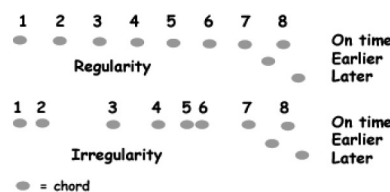

Figure 1: Schematic representation of regular and irregular sequences with the target played "on time", "earlier" or "later" than expected in an isochronous context. In addition to these temporal manipulations, the harmonic relatedness of the target was manipulated (related, less related).

2.2. Results

We observed 1- a main effect of harmonic relatedness (F(1,24)=8.93, p<0.01): shorter response times for related than for less related targets, 2- a main effect of the regularity of the context (F(1,24)=33.36, p<0.001): shorter response times for regular sequences than for irregular ones and 3- a main effect of ending time (F(1,24)=11.69, p<0.01): shorter response times for targets played "on time" and "later" than for targets played "earlier". The effect of harmonic relatedness tended to interact with ending time (p=0.06): shorter response times for related targets were observed only when targets were played "on time" or "later".

DISCUSSION

The harmonic relatedness and the temporal regularities (prime regularity and ending time) influenced chord processing and the effect of harmonic relatedness tended to interact with ending time: facilitated processing of related targets was observed for "on time" and "later", but vanished for "earlier".

3. EXPERIMENT 2

In Exp.1, sequences were played "staccato" in order to make durations of the prime chords comparable in regular and irregular sequences. This control rendered sequences somewhat artificially sounding. In Exp.2, we used the same experimental manipulations as in Exp.1, but sequences were played "legato".

3.1. Method

Participants: Twenty-five non-musician students.

Material & Procedure: The material was as described in Exp.1 except that each prime chord sounded up to the following chord. The sequences were played "legato" (i.e., chords were directly connected and joined). The procedure was the same as in Exp.1.

3.2. Results

We observed as described in Exp.1: 1- a main effect of harmonic relatedness $(F(1,24)=8.22, p<0.01)$ 2- a main effect of the regularity of the context $(F(1,24)=14.45, p<0.001)$ and 3- a tendency of effect of ending time $(p=0.09)$. No other significant effects were observed.

3.3. Discussion

When sequences were played "legato", both harmonic relatedness and temporal regularities influenced chord processing, but no interaction was observed. The difference between Exp.1 & 2 suggests an influence of "musicality of performance" with less artificially sounding sequences (i.e., "legato") enforcing the influence of harmonic relatedness in comparison to temporal regularities.

4. EXPERIMENT 3

Exp.1 & 2 used a priming paradigm to investigate the influence of pitch and time on processing speed. In previous studies on pitch and time in melodies, an interaction between the two dimensions was observed with a subjective task of completion (3). Exp.3 further investigates in how far the observed differences were due to the used task.

4.1. Method

Participants: Twenty-five non-musician students.

Material & Procedure: The material was as described in Exp. 2. The participants were asked to rate the degree of completion of the sequences with an 8-point scale (1=not complete; 8=very complete).

4.2. Results

We observed 1- a main effect of harmonic relatedness $(F(1,24)=44,85, p<0.001)$: sequences were judged more complete when ending on related than on less related targets, 2- a main effect of ending time $(F(1,24)=18,96, p<0.001)$: sequences were judged more complete with targets played "on time" and "later" than with targets played "earlier" and 3- an interaction between the two temporal dimensions $(F(2,48)=11,27, p<0.001)$: sequences were rated more complete when targets were played "on time" or "later" than "earlier" only in the regular sequences.

4.3. Discussion

When participants made global judgments on the sequences, both harmonic relations and temporal regularities influenced the judgments but no interaction between the two dimensions was observed. This result enforces the previous outcome that harmonic relatedness seems to prevail temporal regularities in chord sequences.

5. GENERAL DISCUSSION

In conclusion, our results show that both harmonic relations and temporal regularities influence the processing of a musical event. This suggests that non-musician listeners develop expectancies about what event is coming next and when it will occur. In chord sequences played "legato", the two dimensions are independent in both experimental tasks (local and global judgments). The outcome differs from previously reported interactions between both dimensions for melody perception (3). This difference might be attributed to the difference in material (i.e., melody versus harmony). We are currently investigating the perception of pitch and time in harmonic sequences with an experimental task that has provided further evidence for an interaction in melody perception: listeners had to focus on one dimension and ignore the other, but changes on the ignored dimension influenced performance (4).

6. REFERENCES

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