HARMONIC PRIMING IN AN AMUSIC PATIENT

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ABSTRACT

Harmonic priming studies have provided evidence that the processing of a target chord is influenced by the harmonic relatedness between target and preceding prime context. In the present study, I.R. - a brain-damaged patient exhibiting amusia without aphasia - was tested with the harmonic priming paradigm using a phoneme-monitoring task and a timbre discrimination task. For both tasks, I.R.'s data replicated harmonic priming effects that have been previously reported for healthy college students: target chord processing was faster in harmonically related than in less related contexts. The findings suggest that implicit knowledge of harmonic structures might remain intact and accessible, even when explicit judgments and overt recognition have been lost.

1. THE PRIMING PARADIGM

A musical context influences the perception and processing of a musical event. Harmonic priming research has focused on the investigation of the influence of a harmonic context on the processing of a target chord. In these studies, the harmonic relatedness between the prime context and the target chord is systematically manipulated. Participants make speeded accuracy judgments on a perceptual feature of the target without explicitly judging the manipulated harmonic relations. The same chord is processed faster and more accurately in a harmonically related context than an unrelated or less related context (1, 2, 3). Facilitated processing of related targets has been observed for musicians and nonmusicians, an outcome pointing to the implicit nature of tonal knowledge and the robustness of the involved processes.

Priming paradigms allow investigating the implicit knowledge of the perceiver. In different domains, priming paradigms provided evidence for some spared implicit processing or knowledge in brain-damaged cases (i.e., suffering from alexia, prosopagnosia) who manifest dramatic deficits when explicit judgments are requested. For example, a prosopagnosic patient may be unable to explicitly recognize a face while the familiarity of the face influences the processing of a word presented thereafter (4). The goal of the present study was to assess whether similar priming effects could be obtained in patients with musical disorders (i.e., amusia).

2. THE AMUSIC PATIENT: I.R.

I.R. represents a severe case of amusia that has been extensively studied (5, 6, 7). This patient sustained bilateral cerebral damage that severely impaired music perception and memory. Notably I.R. does not recognize familiar excerpts, does not detect dissonance and fails in melodic and temporal tests asking for direct judgments or comparisons. However, I.R. exhibits normal performance in language tasks, in the recognition of environmental sounds and has no impairment of basic auditory functions.

Our present study tested I.R. with the harmonic priming paradigm in order to investigate eventually spared implicit knowledge on tonal relationships and its influence on musical event processing. Experiment 1 used a phoneme-monitoring task and Experiment 2 a timbre discrimination task. Both tasks have previously provided evidence of harmonic priming in healthy listeners (8, 9).

3. EXPERIMENT 1

In (8), 8-chord sequences were played with a synthesized singing voice, so that the succession of the synthetic phonemes did not form a meaningful, linguistic phrase (e.g., /da fei ku ʃo fa to kei/), and the last phoneme was either the phoneme /i/ or /u/. The harmonic relation of the last chord (i.e., the target chord) was manipulated so that the target was either related or less related (i.e. it acted as a tonic or subdominant chord). The experimental session consisted of 50% of sequences ending on a tonic chord (25% being sung with /i/, 25% with /u/) and 50% ending on a subdominant chord (25% with /i/, 25% with /u/). Participants had to identify as quickly as possible whether the target was sung on /i/ or /u/. Phoneme-monitoring was more accurate and faster when the phoneme was sung on the tonic than on the subdominant. The musical context effects were observed for musically trained and untrained adults, and are currently replicated with 6-year-old children.

3.1. Methods

The experimental material of (8) was used and presented twice in two blocks. I.R. pressed one of two keys to indicate whether the target was sung on the phoneme /i/ or /u/.

3.2. Results

IR obtained high accuracy overall (96%). An ANOVA was performed on correct response times with sequences as random variable (Table 1). The main effect of context was marginally significant ($F(1,11)=3.87, p=.07$), with shorter response times for related targets. Further analysis indicated that the main effect of context was significant in the first presentation block ($F(1,9)=6.21, p<.05$), and tended to interact with the phoneme ($F(1,9)=4.83, p=.056$) - indicating a stronger context effect for the phoneme /u/ ($p<.01$).

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	Related	Less Related
phoneme /i/	987	1028
phoneme /u/	882	1012
timbre A	1351	1561
timbre B	1182	1140

Table 1: Correct response times (in ms) averaged over the testing set for related and less related targets in Exp. 1 (phoneme /i/ and /u/) and Exp. 2 (timbre A and B).

3.3. Discussion

In Experiment 1, a harmonic priming effect was observed for the amusic patient I.R. The responses in the phoneme-monitoring task were faster when the phoneme was sung on a related tonic chord than when it was sung on a less related subdominant chord. The experimental task does not require paying attention to the music, but the finding suggests that I.R. is processing the musical context in an automatic way. The question arises as to whether the priming effect was observed because the task required language processing, which is spared in I.R.. Experiment 2 was designed to further investigate the observed priming effect by using a musical timbre-discrimination task. This task requires participants to quickly process the musical timbre of the target and has been shown to produce harmonic priming effects (9).

4. EXPERIMENT 2

4.1. Methods

Sequences of Exp. 1 were played with musical timbres: the first 7 chords with an acoustic piano sound and the target with either the acoustic piano sound (A) or a harp sound (B). Procedure was as described in Exp. 1, and I.R. pressed one of two keys to indicate whether the target was played by timbre A or timbre B.

4.2. Results

Overall accuracy was high (92%). An ANOVA performed on correct response times with chord sequences as random variable (Table 1) showed an interaction between context and timbre ($F(1,11)=8.52, p<.05$): only for timbre A response times were significantly shorter for related than for less related targets ($F(1,11)=23.57, p<.001$). Response times were faster for B than for A ($F(1,11)=37.95, p<.001$). No influence of presentation blocks was observed.

4.3. Discussion

Experiment 2 showed the facilitation effect for tonic chord processing while using a musical material without phonemes. The stronger effect of context for timbre A and faster response times for timbre B replicated behavioral data observed for healthy college students (9).

5. CONCLUSION

For both phoneme-monitoring and timbre discrimination tasks, I.R.'s data showed harmonic priming effects, as previously reported in healthy college students: target chord processing was faster in harmonically related than in less related contexts. I.R. was sensitive to the harmonic structure of the context and the harmonic relation influences the processing of the target chord. Our present findings suggest that implicit knowledge of harmonic structures might remain intact and accessible, even when explicit judgments and overt recognition have been lost. To further test this hypothesis, we are currently examining the same harmonic material with a direct testing method (i.e., subjective judgments of completion) for both control subjects and I.R..

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