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Concreteness effects in lexical tasks: Access to a mental image?

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In many lexical processing tasks, normal participants perform better with concrete than abstract words (Strain, Patterson, & Seidenberg, 1995). The same pattern has been observed in a number of brain-damaged patients with language deficits, as in the syndrome of "deep dyslexia" (Coltheart, Patterson, & Marshall, 1980). One influential account for these "concreteness effects" is the "dual coding" theory (Paivio, 1986), which argues that concrete words are linked to both a "verbal" and an "imagistic" representation in memory, while abstract words are associated primarily with a "verbal" representation. Empirical evidence in favor of this account mainly comes from studies showing that concreteness effects in tasks of word recall are due to the use of visual mental imagery for concrete words. In the present study, we investigated whether the use of mental imagery also underlies concreteness effects in lexical decision tasks.

We used a dual-task paradigm in which participants had to perform a lexical decision task while simultaneously retaining a square matrix pattern in short-term memory. This concurrent visuo-spatial memory task has previously been shown to interfere with mental imagery (Sims & Hegarty, 1997). Thus, we would expect two possible patterns of performance if participants generate a mental image while processing concrete words in the lexical decision task. First, the retention of the visuo-spatial configuration should interfere with the generation of a mental image for concrete words, thereby reducing the processing advantage of concrete over abstract words in the lexical decision task. Second, the generation of a mental image during the processing of concrete words (if not prevented by the retention of the visuo-spatial configuration) should interfere with the retention and later recognition of the square matrix pattern.

Methods

Three experimental conditions (control, phonological interference and visual interference) were presented in a between-subject design, with 24 French-speaking undergraduate students per condition. In each condition, 200 trials were presented, each trial being subdivided into three phases:

1. *Memorization.* Participants were presented either with (a) a sequence of squares to ignore (control condition); (b) a nonword to memorize (i.e., a combination of 2–3 low-frequency French syllables displayed in upper case, e.g., *BLIKROU*); or (c) a 5×5 grid to memorize with 3–4 randomly-filled cells.
2. *Lexical decision.* Participants were presented with a letter string and were asked to decide whether the item presented was a French word or not. The words consisted of 50 concrete and 50 abstract French words matched for frequency and word length. The 100 nonwords were constructed by changing one letter of each word stimuli.
3. *Recognition.* Participants were presented either with (a) a sequence of lower-case letters and had to decide whether the letters in the string were all identical or not (control condition); (b) a nonword displayed in lower-case and had to decide whether it was the nonword they had to memorize at the beginning of the trial or not (for half of the items a single phoneme had been changed, e.g., *vlikrou*); or (c) a grid and had to decide whether the filled cells were in the same position as in the grid they had to memorize (for half of the grids, the position of one of the filled cells had been changed).

Results

The mean reaction times (RT) and the percentage of errors in all conditions is shown in Fig. 1. We report here the main results of the subject analysis (F_1) and the item analysis (F_2). Word frequency was introduced in all the analyses as an additional variable, but the results for this variable will not be reported, because it did not significantly modulate the effects reported here. The data of one of the subjects in the control condition had to be eliminated due to technical problems.

Lexical decision task

The usual concreteness effect, indicating that concrete words are recognized easier than abstract words, was observed in all three conditions for the RT analysis (control: $F_1(1,22) = 30.05$, $p < 0.001$; $F_2(1,96) = 9.10$, $p < 0.01$; phonological interference: $F_1(1,23) = 27.73$, $p < 0.001$; $F_2(1,96) = 9.28$, $p < 0.01$; visual interference: $F_1(1,23) = 14.94$, $p < 0.001$; $F_2(1,96) = 9.44$, $p < 0.01$) and the error analysis (control : $F_1(1,23) = 40.48$, $p < 0.001$; $F_2(1,96) = 5.34$, $p < 0.05$; phonological interference: $F_1(1,23) = 20.98$, $p < 0.001$; $F_2(1,96) = 5.95$, $p < 0.05$; visual interference: $F_1(1,23) = 29.92$, $p < 0.001$; $F_2(1,96) = 6.28$, $p < 0.02$). This effect was similar in all three conditions as shown by the nonsignificant concreteness × condition interaction (RT analysis: $F_1(2,69)<1$; $F_2(2,192)<1$; error analysis: $F_1(2,69) = 1.57$, $p = 0.22$; $F_2(2,192) = 1.22$, $p = 0.30$).

Recognition task

In the phonological interference condition, the recognition of the nonwords subsequent to the presentation of an abstract word was slower (but not more error prone) than the recognition of the nonwords subsequent to a concrete word (RT analysis: $F_1(1,23) = 7.35$, $p < 0.05$; but $F_2(1,96) = 1.78$, $p = 0.19$; error analysis: all $F < 1$). In the

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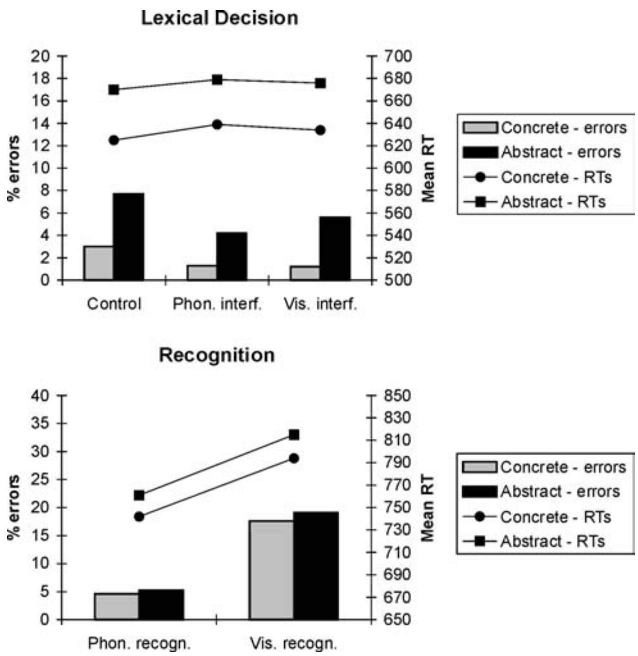

Fig. 1. The upper graph shows the mean RT (ms) and percentage of errors for concrete and abstract words in the lexical decision task with no interference (control condition), phonological interference, and visual interference. The lower graph shows the mean RT (ms) and percentage of errors for items in the phonological and visual recognition task following the presentation of a concrete versus an abstract word.

visual interference condition, the performance in recognizing the grids was not significantly influenced by the preceding word being a concrete or an abstract word (RT analysis: $F_1(1,23) = 2.22$, $p = 0.15$; $F_2(1,96) = 2.29$, $p = 0.13$; error analysis: all $F < 1$) .

Conclusion

The size of the concreteness effect did not reduce in the visual interference condition. Moreover, the participants' performance on the visual recognition task was no worse when they had previously processed a concrete relative to an abstract word. There was thus no evidence that the participants relied on visual imagery in processing concrete words in the lexical decision task. This finding suggests that Paivio's account could be limited to concreteness effects observed in tasks such as word recall, in which participants can rely on explicit strategies. The concrete word advantage observed in normal and brain-damaged participants in lexical processing tasks thus requires an alternative account postulating a similar representational format of semantic information involved in the processing of concrete and abstract words (e.g., Plaut & Shallice, 1993; Schwanenflugel, Harnishfeger, & Stowe, 1989).

References

Coltheart, M., Patterson, K. E., & Marshall, J. C. (Eds.). (1980). *Deep dyslexia*. London: Routledge & Kegan Paul.

Paivio, A. (1986). *Mental representations: A dual coding approach*. Oxford, England: Oxford University Press.

Plaut, D.C., & Shallice, T. (1993). Deep dyslexia: A case study of connectionist neuropsychology. *Cognitive Neuropsychology, 10*, 377–500.

Schwanenflugel, P. J., Harnishfeger, K. K., & Stowe, R. W. (1988). Context availability and lexical decisions for abstract and concrete words. *Journal of Memory and Language, 27*, 499–520.

Sims, V.K., & Hegarty, M. (1997). Mental animation in the visuospatial sketchpad: Evidence from dual-task studies. *Memory & Cognition, 25*, 321–332.

Strain, E., Patterson, K., & Seidenberg, M. S. (1995). Semantic effects in single-word naming. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 1140–1154.