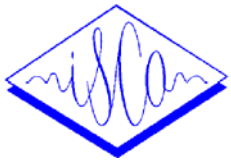

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The effect of semantic distance in the picture-word interference task

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Abstract

First, we investigated whether semantic interference in the picture-word task generalizes from close neighbours to more distant category members. Second, we investigated the operationalisation of semantic distance. The presented work manipulated closely versus distantly related distractor words, and examined to which degree various operationalisations of distance determine semantic interference. Within-category interference did occur, however depending on the quantity and quality of the semantic relationship. The effect was limited to very similar coordinates or semantic neighbours, and did not occur for less similar category coordinates. Furthermore, the associative implementation of semantic distance was most predictive for the interference effect. The findings provide a better understanding of the different measures of semantic distance as well as the process of semantic interference.

Semantic distance

In the picture-word interference task, pictures are named while attempting to ignore simultaneously presented distractors words. Semantically related distractor words have been repeatedly shown to interfere with picture naming (e.g., Lupker, 1979) and this finding contributed significantly to the modelling of speech production. The multitude of studies however failed to produce a precise definition of the required type of semantic relatedness. Semantic coordinate distractors often interfere with picture naming (Costa et al., 2003), but many studies based the selection of coordinate distractors on mere intuition. Yet not all members of the same category may invoke semantic interference, depending on the semantic distance between the two category members.

The present study investigated whether the SI effect occurs when the distractors are semantic coordinates that are neighboring category coordinates (e.g. lion-tiger, ‘neighbors’ for the remainder of the article) or more distant coordinates (e.g. lion-monkey, ‘coordinates’ for the remainder of the article) compared to unrelated distractors.

Furthermore, categorical relatedness can be operationalised in various ways (Ruts et al., 2004). The relatedness is often operationalised by collecting similarity ratings of concept pairs. But the underlying process driving these judgements has been argued to only pertain to a selection of context-

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dependent dimensions, in which the objects under consideration are similar (Medin, Goldstone, & Gentner, 1993). In contrast, relatedness based on the feature- or association-patterns of a concept can be computed independent from context.

The applied semantic distances are based on previously collected norms for similarities, features and associations as described in Ruts et al. (2004). The similarity judgments are pair-wise subjective judgments of similarity judged on a scale going from 1 (totally dissimilar) to 20 (totally similar). The other two semantic distance models are based on a vector space model and correspond closely to the Word Association Model reported by Steyvers, Shiffrin, and Nelson (2004).

Experiment

Method

Each of 44 pictures appeared on a white background along with three distractor words individually superimposed on the picture: (1) a semantic neighbor (e.g., lion on the picture of a tiger); (2) a remote category member (e.g., monkey); and (3) an unrelated word (e.g., window). Each distractor occurred once in the entire set and was closely matched for word frequency. Selection of semantically close neighbors and semantically dissimilar coordinates was based upon previously collected pair-wise similarity norms (Ruts et al., 2004). The average similarity was .73 for the semantic neighbors, and .39 for the coordinates.

The participants were instructed to name the pictures as quickly and accurately as possible. A trial consisted of a fixation point, the picture with distractor, the same picture without the distractor and a blank screen during which the voice key registered responses.

Results and discussion

First, we investigated the interference effects in the three semantic distance conditions. The data were analyzed using a one-factor within-participant ANOVA. Distractor type was significant, $F_1(2,60)=13.16$, $p<.001$, $MSE=1{,}720.58$; $F_2(2,86)=11.04$, $p<.001$, $MSE=6{,}134.03$. Post hoc Tukey tests indicated that neighbors differed significantly from coordinates and unrelated distractors ($p_1<.01$; $p_2<.05$), whereas the unrelated and coordinate distractors did not. In conclusion, only neighbor distractors showed an SI effect.

Table 1. Mean Naming Latencies for Each Condition.

	Neighbors	Coordinates	Unrelated
M	957	915	912
SD	90	650	1100

Secondly, a simultaneous regression was performed on the average latencies of the 88 distractors using three semantic predictors: similarity-, associations- and feature-based semantic distances. Collinearity was verified but turned out not to characterize the data. The regression model was significant with R^2=.19. Only association distances were significant β=.42, SE=65, p<.01. A second model was tested where CELEX log-transformed word-form frequency was added to the list of predictors. T he model was significant, R^2=.26. Again, there was a significant effect of the association predictor, β=.34, SE=53, p<.05.

General Discussion

Three main findings can be derived from the data. First, interference by semantic neighbors result in a 50ms processing disadvantage compared to neutral control words. Second, semantically remote distractors resulted in equally fast responses as the unrelated words. The SI effect is thus not strong enough to affect all category members of a semantic concept. This pattern contradicts early findings by Lupker (1979) where semantic interference was found between concepts that share few semantic properties with the picture. Third, the semantic interference effects correlate to a varying degree with three different measures of similarity. A semantic distance measure based on word associations accounted for a significant part of the naming latencies, but direct similarity ratings and feature based measures did not.

The first two findings indicate that a semantic relationship defined as belonging to the same basic-level category is not a sufficient condition for obtaining a SI effect. Task specific factors such as the SOA of the distractor and the possible set-size of the responses (La Heij & Van den Hof, 1995) could have attenuated the SI effect. But such explanation would retain a similar issue: Why the SI effect is more easily attenuated in coordinate words, as the present experiment setup did suffice for a SI effect in neighbor words. Another factor that needs to be explored is the proportion of related and unrelated distractors in the experiment. In the current study, only one third of the words were truly unrelated to the picture, which might increase habituation to related distractors.

The third finding indicates that the occurrence of a SI effect might depend on how semantic distance is measured (cf. Mahon et al., submitted). The lack of an SI effect might be due to the properties of the semantic dis-

tance model used. A closer investigation of the semantic distance measures can reveal some characteristics of the dimensions or depth of processing from which the SI effect originates. In contrast to the rated similarity and features model, an association model (e.g., Steyvers, Shiffrin, & Nelson, 2004) is based on automatic and more superficial responses. We argue that the semantic information available in speeded task conditions rather resembles the information captured by the association approach than by a model based on rated similarities or features. The association measure used was based only on the first three responses in a word association task (see Ruts et al., 2004). Such close associations may rather reflect the most salient characteristics of the stimuli, whereas similarity judgments are based on more central or causal features. Similarly in feature ratings, participants need to describe the concepts with at least 10 features. Task demands of the similarity and feature ratings might thus over-emphasize causal features as compared to an association task.

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