Task-Irrelevant Environmental Sounds Alter the Difficulty of Semantic Access and Lexical Retrieval in the Picture-Word-Interference Task

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Sensory processing and perception of an object stimulus are the initial steps to object naming. Yet, their role on lexical-semantic access in speech production has been systematically evaded in just about all models of word production (e.g., [1-2]), with the result that the impact of sensory-perceptual factors on lexical-semantic access processes is still largely unknown. The goal of the present study was to explore how semantic and lexical processing of target pictures alter under the influence of a factor known to provide behavioral benefits on object-perception processes, namely: complementary auditory information about an object's identity.

The Paradigm: For the sake of comparability with previous research on lexical-semantic access processes, the study adapted the classic picture-word-interference (PWI) paradigm. Participants saw pictures (e.g., a picture of a cat) with simultaneously appearing distractor words printed on top from either the same (e.g., sheep) or a different semantic category (e.g., saw). In addition to the conventional purely visual conditions, there were four visual-auditory conditions in which short environmental sounds (e.g., "meow") accompanied the visual stimuli. Two of these conditions were bisensory target conditions (i.e., the sound matched the target picture), the other two were bisensory distractor conditions (i.e., the sound matched the object denoted by the word distractor) (see Tabel 1). All sounds started 150 ms before the presentation of the picture-word stimuli and overlapped with them for 350 ms. A pre-test (n = 27) verified clear sound identifiability and no sound ambiguity for any target-distractor pair.

In **Exp. 1,** manual semantic categorization times were measured. The pattern of results showed multisensory effects that were highly consistent with multisensory object-recognition effects (e.g., [3]). Picture categorizations were faster when the auditory input matched the target or belonged to the same semantic category. All other conditions had no effect, compared to the purely visual, unrelated distractor condition baseline (see Fig. 1), suggesting multisensory effects on semantic processes are target specific but when they come into play, they affect semantic access more strongly than verbally instigated semantic co-activation effects do.

In **Exp. 2,** the paradigm was combined with a standard picture-naming task. Results showed that all benefits of multisensory input disappeared (see Fig. 2). Critically, bisensory distractors—regardless of whether related—always elicited interference effects that clearly exceeded linguistically-induced semantic interference. This demonstrates that sensory input matters for lexical-semantic access processes, apparently even more than semantic word contexts do.

References

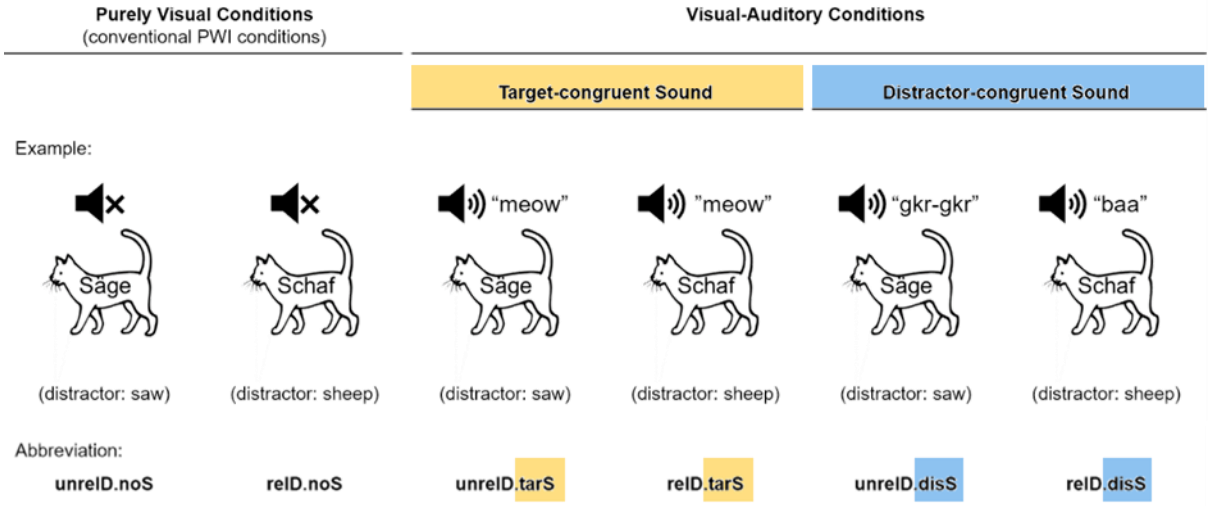
[1] Levelt, W. J., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and brain sciences*, *22*, 1-38.

[2] Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological review*, *93*(3), 283-321.

[3] Molholm, S., Ritter, W., Javitt, D. C., & Foxe, J. J. (2004). Multisensory visual-auditory object recognition in humans: a high-density electrical mapping study. *Cerebral cortex*, *14*(4), 452-465.

Figures and Tables

Table 1: Illustration of the experimental conditions. An English translation of the German word distractors is given in parentheses below the example stimuli.



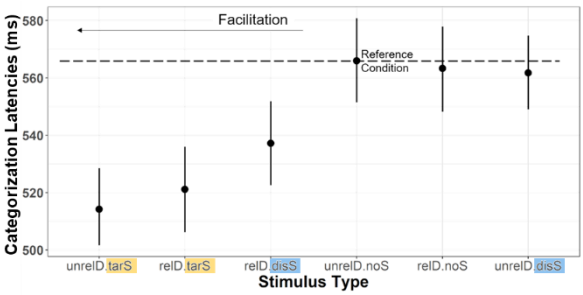


Figure 1: Results of Experiment 1: Mean Picture Categorization Times with 95% *CI*s

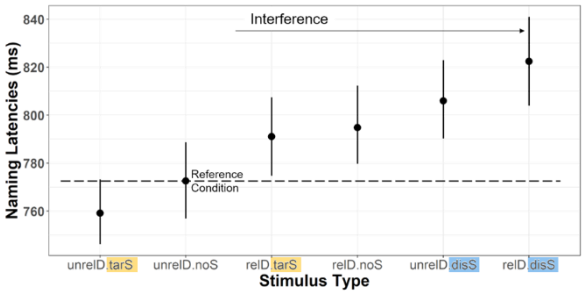


Figure 2: Results of Experiment 2: Mean Picture Naming Times with 95% *CI*s