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Processing visuospatial information during reading and listening: the reading-interference hypothesis

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Modal theories of language comprehension assume that the description of a situation is understood through a mental simulation of the experience of the situation, recruiting the modality-specific mental subsystems that are used in perception and action. A corollary of this assumption is that during language processing, the linguistically conveyed information and information from the comprehender's current real situation interact. Importantly, this interaction is assumed to occur not only in situated communication (i.e., when the linguistically conveyed information is meant to be integrated with information from the current situation), but also when the comprehender does not take the described situation as being related to his or her current real situation. Several studies have provided evidence for this interaction (e.g., Glenberg & Kaschak, 2002).

A hypothesis arising from this theoretical approach is that the modality of the linguistic input (visual vs. auditory) has an impact on the comprehension of visuospatial information. Reading involves the control of eye movements, and this requires the processing of visuospatial information from the real situation. Thus, when visuospatial information about a described situation is to be processed, it needs to compete for resources of the visuospatial subsystems. In contrast, when listening to a description, these subsystems are fully available for comprehension. Thus, the hypothesis is that compared to listening, reading is disadvantageous to the comprehension of visuospatial descriptions. (This hypothesis obviously bears some resemblance to the interference hypotheses proposed by Brooks, 1970, and Eddy & Glass, 1981).

In order to investigate the hypothesis we conducted three experiments. Participants read or listened to short narratives presented sentence-by-sentence (self-paced). There were two versions of each experimental passage, differing with regard to a particular piece of spatial information. Each participant was presented with only one version of a passage. Comprehension of the spatial information was tested by means of a probe-recognition task that named a previously mentioned entity whose accessibility could be expected to differ for the two text versions, provided the participants processed the critical spatial information properly.

In Experiment 1, the two versions of a passage differed with regard to a motion on the part of the protagonist. As a consequence of the motion, the critical entity was either relatively close to or further away from the protagonist at the time of testing. The results for the probe-recognition latencies were in line with the reading interference hypothesis. The interaction modality x spatial distance was significant. The probe-recognition latencies of the listeners were significantly shorter when the target entity was relatively close to the protagonist compared with when it was further away. For readers, no significant spatial distance effect was found.

In Experiment 2, the relevant part of a passage described a static scene, and the two versions differed with respect to the information about the protagonist's gaze direction. The critical entity was either within the protagonist's field of view or outside of it. The result pattern corresponded to that of Experiment 1. Probe-recognition latencies of the listeners but not those of the readers were affected by the manipulation of the spatial information.

Experiment 3 investigated whether the results might be due to the fact that the auditory presentation provided additional information (through intonation) or the fact that the listeners spent

more time on processing the sentences compared with the readers. The same passages as in Experiment 2 were used, but one group of participants read and simultaneously listened to the passages, whereas the other group listened only. A spatial effect was found for the listening-only group but not for the reading-and-listening group, thus speaking against the alternative explanations.

Taken together, the results of our experiments support the hypothesis that the reading process interferes with the processing of visuospatial text information. As to the complete lack of spatial effects in the reading conditions, it is important to bear in mind that the hypothesis does not state that readers generally fail to comprehend and maintain spatial information about a described situation. Rather, it says that readers experience a dual-task condition, and accordingly, that the outcome depends on several factors, for example, whether the reader considers it necessary and is able to use compensatory strategies. In our experiments, no emphasis was placed on the processing of spatial information, neither by prior layout-learning (as is the Morrow paradigm), nor by the content of the narratives, nor the probe-recognition task. Thus, the readers may not have made an effort to overcome the problem. However, there are several additional potentially relevant variables with regard to which the existing studies of spatial information processing during reading differ (for a review see Zwaan & Radvansky, 1978). The reading-interference hypothesis provides a framework for integrating the numerous seemingly inconsistent results.

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