

41. Cross-Modal Priming in the Densely Amnesic Subject K.C. (1997)

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If repetition priming is a perceptual phenomenon, why is it not eliminated when the modality is shifted between study and test? We investigated cross-modal priming in a densely amnesic subject (K.C.) with bilateral hippocampal lesions using a fragment completion task. After making semantic judgments on words in the visual and auditory modality, K.C. was asked to complete visual word fragments with the first word that came to mind. On three separate occasions, K.C. showed robust within-modality priming but no reliable cross-modal priming, suggesting that the latter relies on brain structures damaged in this patient. Our data are compatible with the notion that cross-modal priming in healthy individuals reflects explicit contamination from episodic memory. Conditions that compromise episodic memory, such as amnesia, can abolish the effect.

Rationale. Much research on implicit memory suggests that repetition priming is perceptual in nature and is based on presemantic representations. It is sensitive to changes in perceptual characteristics of target information from study to test and can be observed following study tasks that do not require any semantic processing. Yet, many studies have also demonstrated a small but robust priming effect when the presentation modality is shifted between study and test (e.g. Craik et al., 1994). If priming is a perceptual phenomenon, why is it not reduced to '0' when there is no perceptual overlap between items at study and cues at test? It has been suggested that cross-modal priming reflects the contamination of performance on an implicit test by intentional uses of explicit memory (Jacoby et al., 1996). According to this view, cross-modal priming reflects "leakage" from explicit episodic memory rather than true implicit memory processing. Alternatively, cross-modal priming may be a truly implicit form of memory that is not perceptual in nature but based on conceptual or lexical processing. We decided to investigate this issue by testing cross-modal priming in a densely amnesic subject

who has severe episodic memory impairments but shows no deficits on implicit memory tasks. If the cross-modal priming effect observed in normal subjects reflects "leakage" from episodic memory and is dependent on the integrity of structures damaged in amnesia (e.g., hippocampus), then it should be absent in a densely amnesic patient who has severe damage to these structures and, hence, suffers from a nearly complete loss of episodic memory.

Subject. K.C. is a 45-year-old male who, at the time of this experiment, had been amnesic for 15 years following a closed-head injury in a motorcycle accident. His neuropsychological profile and neuroimaging data have been reported elsewhere (Tulving, Schacter, & McLachlin, 1988). Data from a recent reexamination will be reported at the conference. K.C.'s most recent MRI shows multiple lesions, predominantly in the left hemisphere. His medial temporal lobes show substantial damage bilaterally. We quantified his hippocampal damage using volumetric planimetry. The residual volume of his left hippocampus is only 21% (.4 cm³) of that measured for an age-matched normal control. The volume of his right hippocampus is 39% (.7 cm³) of that of the control. Additional brain damage included left occipital infarction and white-matter encephalomalacia deep to the left frontal and parietal cortex. His IQ, as determined by the WAIS-R, is in the lower normal range (FIQ 88, VIQ 96, PIQ 79). In contrast, his episodic memory functions are severely impaired for verbal and non-verbal material. He scores at chance level on the Warrington Recognition Memory Tests for faces and words. On CVLT immediate recall, he shows virtually no learning across multiple learning trials. He scores five standard deviations below average on delayed recall and recognition of the CVLT.

Methods. We tested priming within the visual modality and from the auditory to the visual modality on three separate occasions. Each session included a study phase that was immediately followed by a test phase. The study phase involved the presentation of 25 words in the visual and 25 words in the auditory modality for a semantic judgment. K.C. had to decide for each word whether it referred to something living or non-living. The test phase involved the visual presentation of 75 word fragments and required their completion with the first word that came to mind. Twenty-five fragments were parts of words that had been studied visually, 25 corresponded to words heard at study, and 25 were fragments of non-studied words. To examine long-term retention of priming, the test phases for items studied in Sessions 1 and 3 were readministered 8 weeks after the completion of Session 3. New non-studied items were used to establish the baseline completion rate. At this point in time, we also administered a recognition memory test for the same items. K.C. was shown the complete words and was asked for each of them whether it had been presented to him before in the context of the living/non-living task. The recognition memory test was administered after the fragment completion task.

TABLE 13
Completion Rates for Visual Word Fragments in Sessions 1-3 as a Function
of Study Condition

Study condition	1	2	3	Mean
Visual (within-modality)	.48	.64	.63	.58
Auditory (across-modality)	.30	.42	.24	.32
Nonstudied	.26	.39	.20	.28

Results and discussion. In each of the three test sessions, K.C. completed a substantially larger proportion of fragments for visually primed items than for non-studied items, indicating preserved within-modality priming (Table 13). For the cross-modal condition, there was virtually no advantage of studied over non-studied items (one item in each session). Considering the total number of items presented and the amount of priming demonstrated within the visual modality, we interpret these data to indicate the absence of cross-modal priming.

To shed more light on K.C.'s priming performance, we also investigated long-term retention effects. Priming on the fragment completion task was examined for the complete sets of items from Session 1 (10 weeks earlier) and Session 3 (8 weeks earlier). Performance on this task was compared with performance on an explicit recognition memory test. There was no sign of cross-modal priming after delays of 8 and 10 weeks, whereas within-modality priming was still present (Table 14). Together with the immediate delay results, these data indicate no evidence for cross-modal priming in K.C. Priming within the visual modality, by contrast, is preserved and long-lasting.

When asked to recognize the previously studied words on the explicit recognition memory test, K.C. performed very poorly regardless of whether items had been studied in the visual or the auditory modality (Table 15). The rate of hits minus false alarms was .20 for both conditions, indicating that K.C.'s severe episodic memory impairment extends to the material used in the present study. It is, thus, extremely unlikely that his performance on the fragment completion task could have been influenced by intentional uses of explicit episodic memory.

TABLE 14
Completion Rates for Visual Word Fragments in Session 4 as a Function of Study
Condition and Delay

Study condition	8	10	Mean
Visual (within-modality)	.46	.37	.41
Auditory (across-modality)	.17	.30	.23
Nonstudied	.28	.28	.28

TABLE 15
Proportion of Old Responses in Delayed Visual Recognition Memory Test as a Function of Study Condition and Delay

Study condition	8	10	Mean
Visual (within-modality)	.56	.48	.52
Auditory (across-modality)	.44	.60	.52
Nonstudied	.32	.32	.32

Conclusions. K.C. showed no evidence for reliable cross-modal priming from the auditory to the visual modality on the fragment completion task. This suggests that brain structures damaged in K.C., possibly the hippocampus, mediate cross-modal priming in normals. Our data are compatible with the notion that cross-modal priming in normals reflects explicit contamination, i.e. leakage from episodic memory, and that conditions which compromise episodic memory can eliminate the cross-modal priming effect.

References

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