Priming

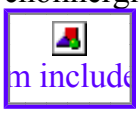
Priming is an increase in the speed or accuracy of a decision that occurs as a consequence of a prior exposure to some of the information in the decision context, without any intention or task related motivation. Since priming occurs in tasks where memory for previous information is not required, and may even have detrimental effects, it is assumed to be an involuntary and perhaps unconscious phenomenon. One of the original demonstrations (Meyer and Schvaneveldt, 1971) of priming occurred in a *lexical decision*task in which a series of decisions is made about whether letter strings are words or not. Priming was shown to occur in cases where two successive letter strings were semantically related words. For example the decision that 'doctor' is a word was faster when the preceding letter string was 'nurse' as compared to 'north' or the non-word 'nuber'. This *semantic priming* effect was explained by a mechanism termed *spreading activation* that had been proposed by Collins and Loft us in a 1975 paper that updated the concepts originally set out by Collins and Quillian. In this new view semantic memory was based on a network that was not strictly hierarchical and for which intersection search was not a suitable search mechanism. Instead Collins and Loftus proposed when the memory representation for a concept is activated the activation spreads to neighboring stored representations. If such a neighbor is presented as the next letter string in a lexical decision (or other) task, it will be identified sooner because it was partially activated by the prime word even before being presented. An underlying assumption is that related words are stored nearer one another (as in Collins and Quillian) than unrelated so that priming is proportional to semantic relatedness. It is important to note that priming occurs in the lexical decision task even though that task does not require participants to remember or use information about letter strings from the previous trials. Priming is therefore believed to occur without intention and is described as an 'automatic' process. It also seems to occur without awareness and is therefore described as an 'unconscious process'. These characteristics distinguish priming from aspects of memory involving deliberate retrieval as used in most episodic memory tests. As is explained below, in the view of many theorists priming and episodic retrieval are actually examples of two different kinds of memory: *implicit and explicit memory*.

Implicit and explicit are terms that have been used in multiple ways in discussions of memory. In the simplest sense they represent a distinction between two ways of measuring a change in memory. An *explicit memory test* specifies to the subject that their memory is being tested. Explicit memory tests may use a variety of procedures including free recall, cued recall or recognition tests. *Implicit memory tests* are indirect and provide neither instructions nor any task related incentive to base one's responses on memory for prior experimental events. A second sense of these terms refers to the nature of the retrieval processes that is used in the two kinds of test. *Implicit retrieval* is said to occur automatically and without awareness, and *explicit retrieval* as a result of controlled retrieval efforts, intention and awareness. And finally the two terms have sometimes been interpreted (Schacter, 1992) as references to distinct forms of memory, implemented by different brain circuits. The claim that implicit and explicit memory tests rely on different mechanisms is justified only if some difference in remembering can be found besides the impression that one is conscious and the other is not. An important experiment in this regard was conducted by Larry Jacoby (1983). The experiment consisted of two phases that were administered a week apart. In the first, participants viewed words under one of three conditions: read aloud, inspect, and generate. In the generate condition a noun was shown to the participant who then generated its opposite from memory(e.g. light - dark). In the read aloud condition the word 'dark' was shown and the participant read it aloud. In a third condition the pair light-dark was shown to the participant who was asked to read 'dark' aloud. In all conditions, then, the word 'dark' was produced as a vocal response, but only in the last two was it seen as a printed word. In the second phase of

the experiment the same participants returned and were asked to take part in either an implicit or explicit memory task. The implicit task was tachistoscopic recognition and the words presented included those like 'dark' that had been used in the earlier phase of the experiment. However the task was simply to name the word that flashed in the tachistoscope, not remember anything about it from the earlier phase. In contrast the explicit task presented the same test words to participants and asked them to decide whether each had occurred in the earlier session. The results 

show that the two forms of memory test were affected in opposite ways by the original three conditions. Words that were generated had an advantage in explicit memory over words seen and read, but words seen and read provided more priming on the implicit memory test.

The priming observed in Jacoby's 1983 study was based on repetition of a word that was visually presented in both phases of the experiment, and occurred in a type of task (tachistoscopic identification that places a premium on efficient perceptual processing. The implication is that priming is related to perceptual processing. In fact it can be shown that priming is not only dependent on repeating information in the same modality but that it also depends on repeating the same patterns and shape elements. For example priming can be observed in word completion tasks that present a word fragment and require that the complete word be generated. Suppose that the fragment EL_P_A_T is presented and you correctly respond with ELEPHANT. Later in the series of fragments you again encounter EL_P_A_T and it is observed that the time taken to complete the fragment is less on this second attempt. That's priming. However if the second fragment is E_E_HA_T, your completion time is not faster than the first: no priming occurs even though the same response (ELEPHANT) occurs on both presentations. Visual priming effects in word fragment completion tasks are also reduced by changes in type font. The implication is that priming is dependent on the input data rather than on making the same response twice. (There are other tasks like naming where response priming does occur, however). In the mid 1980's Graf published a series of papers that compared amnesic patients on priming and episodic recall tasks. The results led to the theory (Graf and Schacter, 1985) that implicit and explicit memory tasks tap into distinct brain systems. Priming effects are said to arise in the perceptual representation systems (PRS) that permit us to translate sensory inputs into perceptions of objects, faces, or words. The visual components of the PRS are located in the occipital and posterior temporal lobes. Episodic memories are formed and retrieved by the system that Mishkin refers to as the cognitive memory system that includes structures in the medial temporal lobe, thalamus, basal forebrain cholinergic system, and frontal lobes.



Damage to any component of this circuit produces amnesia: a deficit of episodic memory. In the studies published by Graf it was shown that amnesic patients have normal priming, which implies that implicit memory survives amnesia.

In the first study Graf, Squire, & Mandler (1984) had groups of normal and amnesic subjects first read a list of common words, without instructing them that there would be a subsequent memory test. Subsequently they were shown visually the first three letters of each word and asked to complete the fragment. When the instructions were to complete the fragment with the word that was seen earlier, which is an explicit memory test, the amnesic patients were at a disadvantage. However when the same fragments were seen with instructions to complete the fragment using the first word that comes to mind, the amnesics used the words from the first part of the study as often as normals did. Amnesia did not impair priming, measured as an

unintentional influence of words from the list on performance of fragment completion.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A second study by Graf, Shimamura, and Squire (1985) repeated this comparison and in addition compared the effects of visual and auditory presentation of the list of words in the first phase of the experiment. As in the earlier experiment the fragment completion task was based on visual presentation of the fragment.Results are shown here 
Amnesic. When fragment completion was to be based on epiosodic recall performance was again impaired in the amnesic patients and their disability was present whether the initial list had been seen or heard. On the implicit version of the task normals and amnesics again showed the same amount of priming, but this was much reduced by the auditory presentation. This finding fits with the theory that priming arises in the PRS system and represents a tuning of perceptual processing. Since the PRS is not part of the cognitive memory circuit amnesia that arises in that circuit does not reduce priming. However when prime and target occur in different sense modalities they do not share the same PRS and priming is then reduced.