



Emotional memory is perceptual

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Abstract

In two experiments it was investigated which aspects of memory are influenced by emotion. Using a framework proposed by Roediger (*American Psychologist* 45 (1990) 1043–1056), two dimensions relevant for memory were distinguished the implicit–explicit distinction, and the perceptual versus conceptual distinction. In week 1, subjects viewed a series of slides accompanied with a spoken story in either of the two versions, a neutral version, or a version with an emotional mid-phase. In week 2, memory performance for the slides and story was assessed unexpectedly. A free recall test revealed superior memory in the emotional condition for the story's mid-phase stimuli as compared to the neutral condition, replicating earlier findings. Furthermore, memory performance was assessed using tests that systematically assessed all combinations of implicit versus explicit and perceptual versus conceptual memory. Subjects who had listened to the emotional story had superior perceptual memory, on both implicit and explicit level, compared to those who had listened to the neutral story. Conceptual memory was not superior in the emotional condition. The results suggest that emotion specifically promotes perceptual memory, probably by better encoding of perceptual aspects of emotional experiences. This might be related to the prominent position of perceptual memories in traumatic memory, manifest in intrusions, nightmares and reliving experiences.
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1. Emotional memory is perceptual

The idea that emotional events are better memorized than neutral events is widespread. It is tempting to attribute a functional value to this phenomenon, as emotions signify information that is potentially important for survival. A superior recollection of emotional events might help the organism to better cope with both negative and positive events, i.e. it might help to optimally adapt to the environment. Dozens of animal and human studies have indeed yielded evidence for the idea that emotional events are better memorized than neutral events (e.g., Cahill & McCaugh, 1996a, b; Christianson, 1992; Roozendaal, 2000). Pharmacological studies have demonstrated that peripheral epinephrine plays a role in this emotion effect, as it stimulates via peripheral β -epinephrine receptors the release of central norepinephrine that stimulates the amygdala, which in turn modulates the storage of memory material (Cahill, Prins, Weber, & McCaugh, 1994; Cahill & McCaugh, 1998; McCaugh, 1992; van Stegeren, Everaerd, Cahill, McCaugh, & Gooren, 1998, but see O'Carroll, Drysdale, Cahill, Shajahan, & Ebmeier, 1999).

Whereas animal research on emotional learning has concentrated on procedural memory (i.e., retention of escape behavior trained in an aversive conditioning paradigm; McGaugh et al., 1993), most human research so far has focused on explicit memory, i.e. has used free recall tests and recognition (multiple choice) tests to assess the retention of stimuli presented during an encoding phase. This is a rather restricted approach, which is problematic for at least two reasons. First, it is well known that memory is not a uniform concept. Memory has many facets, and memory performance depends on the type of memory processes and type of memory material involved. Thus, from a theoretical point of view it is important to investigate various memory processes to get a more complete picture of the influence of emotion on memory. Second, there is one clinical problem for which a better understanding of emotional memory is highly relevant, posttraumatic stress disorder (PTSD). PTSD is thought to be characterized by two seemingly contradictory memory phenomena: a facilitated memory of the traumatic event, as is evident from reliving experiences, intrusions, and nightmares, as well as an inhibited memory, the inability to (voluntary) remember important aspects of the trauma (APA, 1994). The two contrary memory phenomena might be related to specific memory processes, from which it follows that it is important to investigate different memory processes as they relate to emotion.

The idea that specific memory processes play a role in producing PTSD symptoms has indeed been put forward. Ehlers and Clark (2000) have proposed that data-driven processing is particularly strong during traumatic experiences, that is the processing of perceptual information, to explain the poor integration of traumatic memories, their perceptual qualities, and their involuntary triggering in PTSD. Ehlers and Clark (2000, p. 331) tend to associate data-driven processing and the resulting perceptual memories with aspects of implicit memory, that is the types of memories that can be involuntary triggered, especially by “perceptual

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