

The role of emotion in memory

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Does emotion help us remember? That's not an easy question to answer, which is unsurprising when you consider the complexities of emotion.

First of all, there are two, quite different, elements to this question. The first concerns the emotional content of the information you want to remember. The second concerns the effect of your emotional state on your learning and remembering.

The effect of emotional content

It does seem clear that, as a general rule, we remember emotionally charged events better than boring ones.

Latest research suggests that it is the emotions aroused, not the personal significance of the event, that makes such events easier to remember.

The memory of strongly emotional images and events may be at the expense of other information. Thus, you may be less likely to remember information if it is followed by something that is strongly emotional. This effect appears to be stronger for women.

It does seem that memories are treated differently depending on whether they are associated with pleasant emotions or unpleasant ones, and that this general rule appears to be affected by age and other individual factors. Specifically, pleasant emotions appear to fade more slowly from our memory than unpleasant emotions, but among those with mild depression, unpleasant and pleasant emotions tend to fade evenly, while older adults seem to regulate their emotions better than younger people, and may encode less information that is negative.

An investigation of autobiographical memories found that positive memories contained more sensorial and contextual details than neutral or negative memories (which didn't significantly differ from each other in this regard). This was true regardless of individual's personal coping styles.

- Emotionally charged events are remembered better
- Pleasant emotions are usually remembered better than unpleasant ones
- Positive memories contain more contextual details (which in turn, helps memory)
- Strong emotion can impair memory for less emotional events and information experienced at the same time
- It's the emotional arousal, not the importance of the information, that helps memory

The effect of mood

Another aspect of emotion is mood - your emotional state at the time of encoding or retrieving. There has been quite a lot of research on the effect of mood on memory. It is clear that mood affects what is noticed and encoded. This is reflected in two (similar but subtly different) effects:

- mood congruence: whereby we remember events that match our current mood (thus, when we're depressed, we tend to remember negative events), and
- mood dependence: which refers to the fact that remembering is easier when your mood at retrieval matches your mood at encoding (thus, your chances of remembering an event or fact are greater if you evoke the emotional state you were in at the time of experiencing the event or learning the fact).

An interesting issue in the study of emotion is the degree to which what we feel is influenced by our expression of it. In other words, does a person who conceals what they are feeling feel as deeply as a person who openly displays their emotion? Does the expression of emotion, in itself, affect what we feel?

I remember reading Paul Ekman (the guru of interpreting facial expressions, and author of several books on the subject) say that, when practicing the expressions, he found himself experiencing the emotions they expressed. However, accurate expression of emotion does seem to require considerable expertise (if the emotion is not, in fact, being felt) - people are very good at distinguishing false expressions of emotion.

The way people go about controlling their reactions to emotional events does seem to affect their memory of the event. People shown a video of an emotional event and instructed not to let their emotions show were found to have a poorer memory for what was said and done than did those who were given no such instructions.

However, as with emotional content, we cannot simply say that emotional state affects memory. The nature of the emotion being felt is also important. And this, too, is not straightforward. We cannot simply say, for example, that anxiety impairs memory and happiness improves it.

A small study in which participants performed difficult cognitive tasks after watching short videos designed to elicit one of three emotional states (pleasant, neutral or anxious), found that mild anxiety improved performance on some tasks, but hurt performance on others. Similarly, being in a pleasant mood boosted some kinds of performance but impaired other kinds.

This may have something to do with different emotions being involved with different brain regions.

- Remembering is easier when your mood matches the mood you were in when experiencing/learning the information
- The stronger the emotions aroused, the greater the effect on memory
- Emotions can be evoked, or minimized, by displaying or suppressing expressions of emotion
- Different emotional states may impair or help memory, for different memory tasks

Brain regions involved in the emotion-memory interaction

The brain region most strongly implicated in emotional memory is the [amygdala](#). The amygdala is critically involved in calculating the emotional significance of events, and, through its connection to brain regions dealing with sensory experiences, also appears to be responsible for the influence of emotion on perception - alerting us to notice emotionally significant events even when we're not paying attention. The amygdala appears to be particularly keyed to negative experiences.

But it is not only the amygdala that is involved in this complex interaction. The [cerebellum](#), most strongly associated with motor coordination skills, may also be involved in remembering strong emotions, in particular, in the [consolidation](#) of long-term memories of fear.

Parts of the [prefrontal cortex](#) also appear to be involved. One study found that a region of the prefrontal cortex was jointly influenced by a combination of mood state and cognitive task, but not by either one alone. Another study found that the [dorsolateral prefrontal cortex](#) is more active when the participants were surprised by unexpected responses.

Is surprise an emotion? I think surprise is right there in the fuzzy border between two related phenomena - emotion and attention. Interestingly, our understanding of these two phenomena is about on a par - still woefully inadequate (but greatly improving!).

The relationship between emotion and attention

Research suggests that emotional stimuli and "attentional functions" move in parallel streams through the brain before being integrated in a specific part of the brain's prefrontal cortex (the [anterior cingulate](#)). This is why emotional stimuli are more likely than simple distractions to interfere with your concentration on a task such as driving.

We now think that attention is not, as has been thought, a global process, but consists of at least three distinct processes, each located in different parts of the frontal [lobes](#). These are:

1. a system that helps us maintain a general state of readiness to respond;
2. a system that sets our threshold for responding to an external stimulus; and
3. a system that helps us selectively attend to appropriate stimuli.

Correspondingly, emotional arousal helps us maintain a "readiness to respond", and also has a selective effect on the particular stimuli we notice and encode. Perhaps, indeed, attention may be thought of as a state of activity that is triggered by various kinds of emotional arousal, and modulated by such arousal.

How do emotions affect memory?

Well, we're still foggy on details, but there appear to be two main aspects to this. One is that stress hormones, such as cortisol, interact with the amygdala. The other is that the amygdala can alter the activity of other brain regions. One of the ways in which it does this is by acting on [consolidation](#) processes (principally in the [hippocampus](#)).

It is perhaps this effect on consolidation that is reflected in a study using facial stimuli (involving inversion of eyes and mouth to change the emotional impact of a face without significantly changing its visual features), that indicated that the emotional load of a stimulus does not in fact affect the way we perceive it but does have an effect on how we become used to it if we see it many times.

Notwithstanding this study, however, it does seem clear that, in some circumstances and for some types of stimuli, at least, the emotional attributes of a stimulus do affect the way we perceive it and process it - that is, the encoding of the memory.

One of the ways in which it might do this is through the involvement of different brain regions depending on the nature of the emotion experienced. A recent imaging study found that positive emotional contexts evoked activity in the right [fusiform gyrus](#) (among other regions), and negative emotional contexts evoked activity in the right amygdala.

Another way in which emotions might affect memory encoding is through [working memory](#). It has been suggested that, in the case of anxiety, part of working memory may be taken up with our awareness of fears and worries, leaving less capacity available for processing. In support of this theory, one study found that math-anxious people have working memory problems as they do math.

Age and gender differences

It also seems that there are differences in the way men and women process emotional memories. Women are better at remembering emotional memories. They also seem to be more likely to forget information presented immediately before emotionally charged information. This suggests that women are more affected by emotional content - a suggestion compatible with the finding that women and men tend to encode emotional experiences in different parts of the brain. In women, it seems that evaluation of emotional experience and encoding of the memory is much more tightly integrated.

There is also an age difference. The tendency to let unpleasant memories fade faster than pleasant ones gets stronger as we age. This is perhaps a reflection of older people's apparent ability to regulate their emotions more effectively than younger people, by maintaining positive feelings and lowering negative feelings. Preliminary brain research suggests that in older adults, the amygdala is activated equally to positive and negative images, whereas in younger adults, it is activated more to negative images. It may be that older adults encode less information about negative images.

It has also been speculated that age-related cognitive decline may be partly caused by a greater cortisol responsivity to stress.

- The key player in the processing of emotional memories appears to be the amygdala
- Other brain regions, in particular the prefrontal cortex and the cerebellum, are also involved
- While these regions are important for all, men and women do show differences in the parts of the brain they use to encode emotion
- Emotion and attention are related phenomena
- Emotion acts on memory at all points of the memory cycle - at encoding, consolidation, and retrieval
- Emotion acts on memory in various ways, including the production of stress hormones, use of working memory capacity, and involvement of particular brain regions