

# The Adaptive Significance of Regret

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Regret seems such a negative emotion, worrying about what might have been rather than about what could be. It seems so maladaptive and at best some redundant extension of feelings that are worthwhile.

However looking at it more deeply it turns out to not only be a well adapted feeling, but one that demonstrates the rich interactions between different levels of cognition: rational thought, vivid imagination and basic animal conditioning.

Particularly interesting is the role that quite complex assessments of probability plays in regret – the closer you were to averting a disaster but failed, the worse it seems!

To understand regret though we should start with Pavlov, Skinner and basic behavioural conditioning. This is the basis of learning and is present in all but the most basic animals. The mechanism is straightforward – if you do an action and something unpleasant happens you learn not to do it! If one thinks in terms of neuron activation the mechanism for this is quite straightforward: when an area is active and something good happens it becomes associated with the goodness and vice versa. In general things that happen near simultaneously get associated and good/bad feelings are a special (although very special) case.

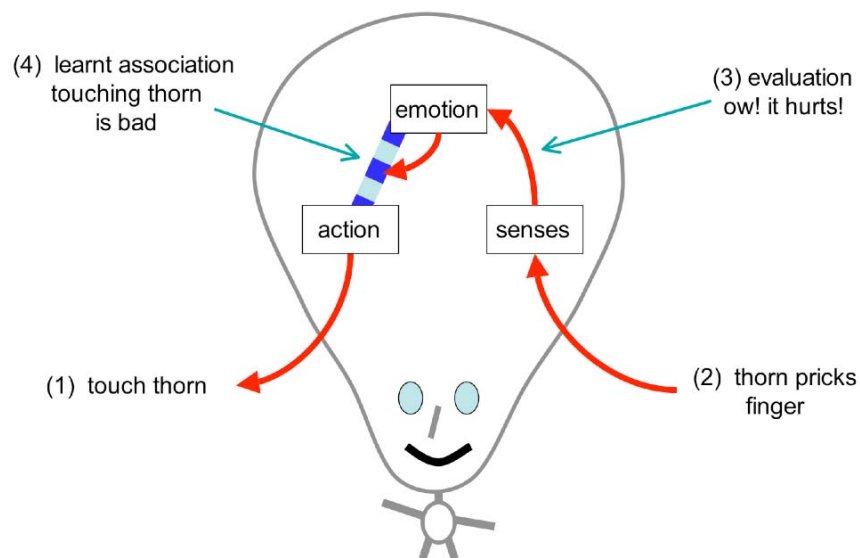


Fig. 1 simple associative learning

For learnt associations, when the stimulus is presented again, the same neurons activate [[or neuron patterns]] the links to the good/bad feelings then cause you to feel what you did when the original stimulus occurred. For actions things are a little more complicated, but not excessively so. When you are about to perform an action there is a moment of preparedness with patterns of activity that cause the negative or positive feelings causing you to continue or stop.

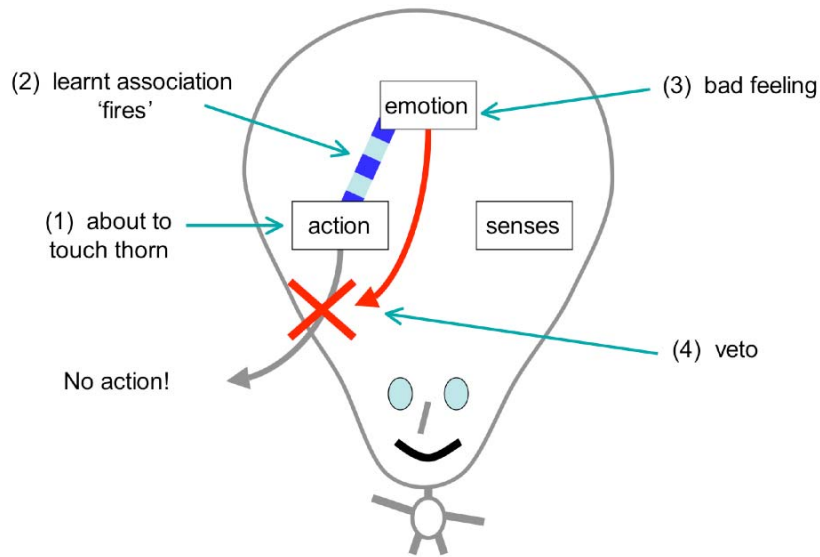


Fig. 2 learnt association prevents you doing bad things

For more complex animals if there is any level of planning then this brings to mind (imagination) the planned actions and expected stimuli and these cause many of the same activations that the actual stimuli and actions would. These activations caused by the imagined events are almost as real and give rise to the positive or negative feelings that would be associated with the actual action or stimuli.

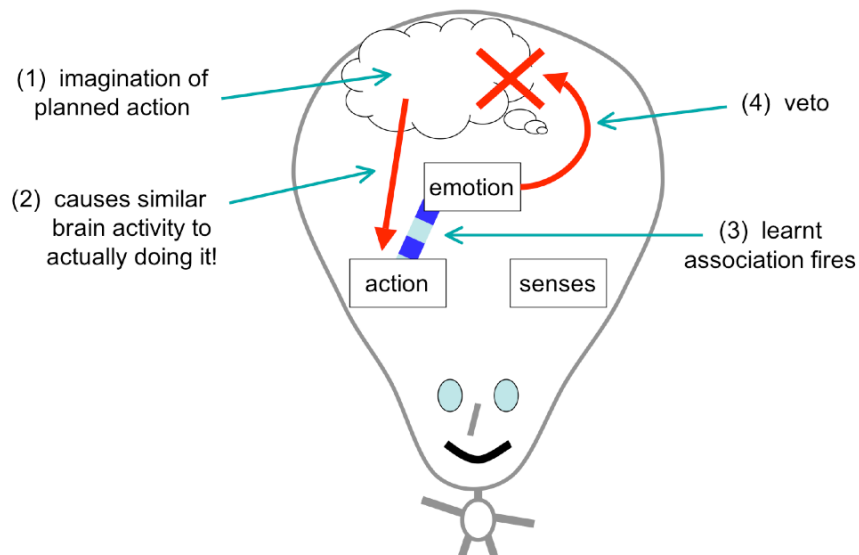


Fig. 3 learnt associations during planning

Of course things never happen absolutely simultaneously, but likewise if brain activation decays slowly then by the time the bad consequence occurs the areas associated with the last action are still active enough to cause learning. Even early experiments in the area showed that the level of learning drops off very rapidly with time corresponding to the decay in brain activity.

Note how the imagination in the planned activity allowed the replay part of learning to operate in a non-instantaneous way. In the same way imagination is recruited to allow us to learn non-instantaneous associations.

Imagine you touch a plant and a few minutes later find that you are sore where you touched the plant. You think “why” and bring to mind recent *salient* events. The salience is important, out of the numerous sensory stimuli you have experienced or actions you have performed you focus on a few, the rare stimuli, or planned or unusual actions. This selection of the salient requires additional mechanisms and is essential, but we’ll move on for now and follow the story of regret.

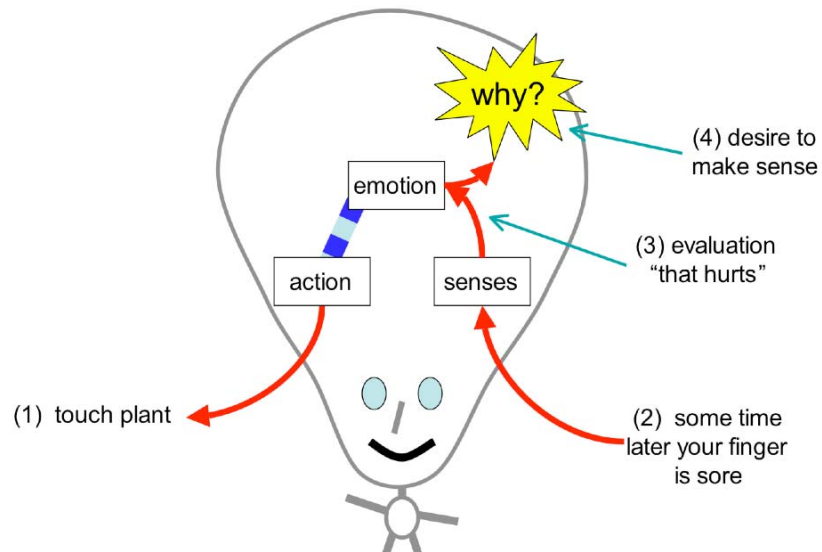


Fig. 4 delay makes it hard to form association

So, you have thought “why” and recall touching the plant and now the finger that you used are hurting. The two are brought together in your imagination and are effectively simultaneous. The imagined touching of the plant and the recalled negative feelings associated with the soreness are present together and the association is formed.

Note that a crucial element of this is the near simultaneity of imagined events. Recall your first term in high school. Many things happened, but in some sense you can imagine it all in one go. For sequence of events, because we focus on just a few highly salient events (salient that word again!), we can replay potentially lengthy sequences in fast forward.





This lesser feeling of regret when things you did were less significant in the result and greater when what you did almost tipped the scales and made a difference is perfectly sensible. The higher emotional intensity will naturally lead to higher levels of learning and stronger negative feelings attached to the action next time you consider performing it.

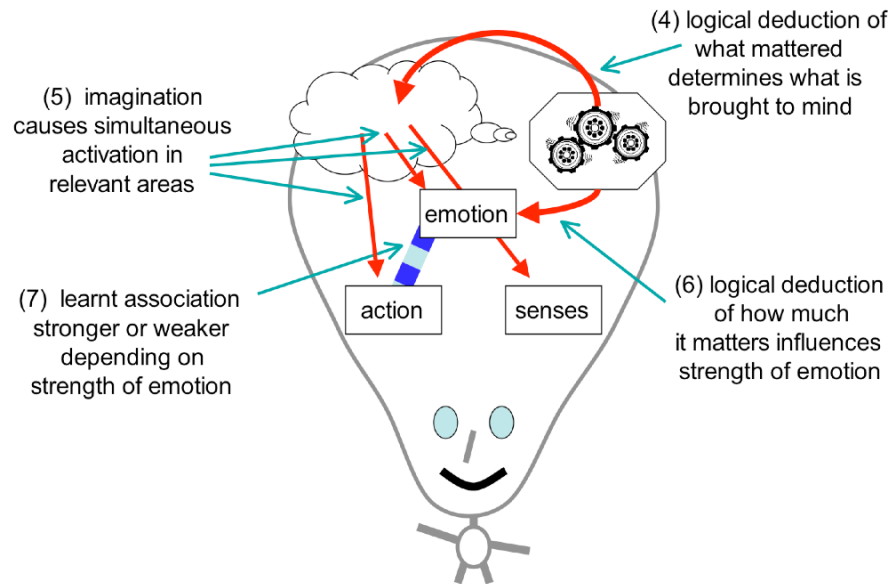


Fig. 8 credit assignment tunes our learning (ctd. from Fig 6.)

So our higher-level rational thinking plays two roles in driving lower-level associative learning; it selects what appears in the imagined 'sad story' narrative and also adjusts the emotional level. So we have a beautiful interchange between new, possibly uniquely human, cognition and old very ancient cognition mediated by imagination and emotion ☺

In summary, regret is a subtle and well-adapted mechanism that enables us to learn effectively from the past recruiting deep 'old' mechanisms. However, as with many aspects of our bodies and minds that are well adapted for the human as caveman, regret causes us problems in more modern settings. In particular, although regret allows us to manage "if only" the mechanisms do not deal with more complex modalities such as "if only but I couldn't have known", or "if only, but it will never happen again". Whilst we may be able to do the reasoning for these (although the former seems to elude many), they do are not able to mollify the emotional reactions of regret.

Finally, you may have noticed how the story starts with general association good or bad, but moved to consider regret, negative emotion only. Why is there no word for the positive equivalent of regret "it worked but only because"? Empirical studies in economics and psychology show that humans have a tendency to weigh negative results more strongly than positive ones, perhaps because 'in the wild' not learning to avoid bad things may kill you whereas missing good things simply means you have to try another time. As an adaptive mechanism regret shows that not only are negative effects stronger, but that we have additional mechanisms for negative emotion that simply do not exist for their positive counterparts.