Emotional Thought or Thoughtful Emotions?

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Abstract

The anatomical circuits for emotion are straightforward: prefrontal cortex, ventral striatum, and the amygdala. However, neurophysiologists have not yet uncovered any robust neurophysiological differences among what we perceive to be as radically different emotions. Nevertheless, they believe that someday, they will be able to discover local anatomical or physiological differences among our different emotional states. However, it might be the case that part of what determines what an emotion is is a higher-order cognitive interpretation. An activated amygdala-frontal lobe circuit under circumstances of duress could either be interpreted, and hence experienced, as fear or as anger or even as surprise or joy, depending upon which cognitive schema was active at the time. Which interpretation we chose or use depends upon our own cognitive histories, and the particular environmental circumstances surrounding the event. Neuroscience can gesture towards the areas in the brain in which interpretations of our autonomic reactions occur, but it cannot tell the full story, for that will require a much richer story concerning what our activated and dynamical brain circuits refer to in the world than they now have. Our best theory of emotion will be a non-reductive one.

In *The Expression of the Emotions in Man and Animals*, Darwin (1872) argues that different species express emotions in essentially the same way: we all scream, sulk, snarl, and sigh. Since that time scientists have constructed substantial research programs based on this assumption. In particular, imaging studies in rats, monkeys, and people are coalescing around the conclusion that homologous neural circuits are responsible for the basic emotions (e.g., fear) across mammals (cf., Mlot 1998). However, other experiments indicate that there are no detectable neurophysiological differences among several of our emotional responses (Cf., Strongman 1996). The difference between being afraid and being angry must come from somewhere; one suggestion is that we interpret our neurophysiological states differently, depending upon which psychological "schemata" are active at the time (Mandler 1984). Allow me to explain.

The anatomical circuits for emotion appear rather straightforward: prefrontal cortex, ventral striatum, and, most importantly, the amygdala. Our limbic system has been known and actively investigated since the 1950's. Recently the details of these areas and how they work have become clearer. For example, LeDoux has shown that messages of fear in rats travel from the senses to the lateral nucleus in the amygdala and then from the central nucleus out to the rest of the brain (cf., Mlot 1998). Humans apparently work in a similar fashion (LeBar et al. 1995). Imagining studies confirm that the amygdala lights up under stress and those with lesions in the amygdala cannot process negative expression on the faces of others (LeBar et al. 1998).

Research is also showing that early experiences of fear and stress significantly affect later neurophysiological development (Robbins 1998). And what the stressor is determines the developmental changes. Early isolation in rats gives rise to later over-excitability. Early and repeated separation gives rise to later depression. Perhaps human are not different here either; early experiences may partially determine our later personality traits or temperament.

The difficult question is how to go from these sorts of facts to understanding human emotions in all their complexity. Most studies, in both rats and humans, concern very simple and basic emotional responses. Most, in fact, concern fear and stress. Our emotional life, however, is quite complicated, subtle, and nuanced. Even if we leave aside the more complex feelings, such as righteous indignation, we still experience a wide range of emotional phenomena. What sort of neurophysiological markers are there that distinguish fear from anger, say, or surprise from joy? We can tell those emotions apart quite easily from the inside, as it were. Can we from the outside?

The short answer is, no, we cannot. Scientists have not yet uncovered any robust neurophysiological differences among what we perceive to be as radically different emotions. For example, we have no trouble discerning when we are afraid versus when we are angry, yet the neural circuits that appear to be active during both of these reactions are essentially the same.

Since the mid-1970's, cognitive psychologists have been advocating cognitive theories of emotion. These hold that what determines the "feel" of some emotional experience or other is our (cognitive) interpretation of our autonomic reaction. Humans are designed to assign singular meanings to incoming sensory data. We see a pair of Necker cubes as both pointing in or out, but never either way at the same time, or no direction at all.

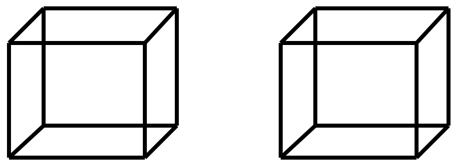

Figure 1: Necker Cubes

These "meanings" are grouped together internally in schemas which we use to parse our world. Which interpretation we chose or use depends upon our own cognitive histories, which shape our schemas, and the particular environmental circumstances surrounding the event. For example, if male college students look at pictures of beautiful women after exercising, they will interpret their increased heart rate, etc., as sexual arousal. If they exercise without the benefit of the pictures, they will interpret the same changes in heart rate and their autonomic system as physical exertion (Cantor, Zillman, and Bryant 1975). Psychologists argue that we interpret emotional changes in our bodies in the same way (cf., Strongman 1996). This would mean that an activated amygdala-frontal lobe circuit under circumstances of duress could either be interpreted, and hence experienced, as fear or as anger or even as surprise or joy, depending upon which cognitive schema was active at the time.

Most neurophysiologists operate under the reductionist assumptions that if they probe deeply and carefully enough into the brain, then they will be able to discover anatomical or physiological differences among the different emotional states. In contrast, cognitive psychologists claim that this sort of reductionist approach cannot work, for part of what determines what the emotion is is a higher-order cognitive intervention. The "feel" of the feeling depends upon what we believe our emotional state should be. Any complete theory of emotion should reflect our best theories of cognition as well as our best neurophysiological data.

The following deep theoretical questions confront us: In order to understand the complex emotions of humans fully, do we need better biological markers, or are some aspects of emotion going to be fundamentally cognitive, interpretive, higher ordered? At what level of processing in the mind/brain do emotions occur (and should any artificial models of emotion track)? Can we reduce emotions and emotional experiences to particular activated circuits in the brain, or are these states essentially tied to our understanding of meaning and mindedness?

For now, the best data suggest that the emotions of humans, and most likely other creatures as well, are fundamentally and inescapably tied to our interpretive abilities. Hence, a purely reductive approach in analyzing them will miss important aspects of our emotional experiences and will be less well suited to predict behavior than a more cognitive model. Nevertheless, claiming that emotions are partially cognitive does not make them mysterious or exempt from detailed scientific scrutiny. As our appreciation for brains being systems embedded in a world increases and we are better able to connect activations in neural networks with meaningful events in the world, then our theories of emotions will become better as well.

In short: emotions are wonderfully recursive phenomena. They shape later cognitive processing, which then shapes our emotional reactions. At the moment, neuroscience can gesture towards the areas in the brain in which these events occur, but it cannot tell the full story, for that would require a much richer story concerning what our activated and dynamical brain circuits refer to in the world than they have. Our best theory of emotion will be a non-reductive one.

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