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The subjective experience of emotion: a fearful view

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We argue that subjective emotional experience, the feeling, is the essence of an emotion, and that objective manifestations in behavior and in body or brain physiology are, at best, indirect indicators of these inner experiences. As a result, the most direct way to assess conscious emotional feelings is through verbal self-report. This creates a methodological barrier to studies of conscious feelings in animals. While the behavioral and physiological responses are not 'emotions,' they contribute to emotions indirectly, and sometimes profoundly. Whether non-verbal animals have emotional experiences is a difficult, maybe impossible, question to answer in the positive or negative. But because behavioral and physiological responses are important contributors to emotions, and the circuits underlying these are highly conserved, studies of animals have an important role in understanding how emotions are expressed and regulated in the brain. Conflation of circuits that directly give rise to conscious emotional feelings with circuits that indirectly influences these conscious feelings has hampered progress in efforts to understand emotions, and also to understand and to develop treatments for emotional disorders. Recognition of differences in these circuits will allow research in animals to have a lasting impact on understanding of human emotions as research goes forward.

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The English word 'emotion' is based on the Latin *emovere*, which means "to move away from." When first applied to psychological events in the 17th century, it pointed to an excited state of mind that causes movement (behavior). This is still the most common meaning of emotion in everyday vernacular speech. But in scientific discussions, the noun 'emotion,' or its adjectival form 'emotional,' are variably used to refer to subjective experiences, behavioral movements, physiological responses, and/or cognitions that contribute to any of the above. Given this multiplicity of referents, it is not surprising that there is debate and confusion about the nature of emotions [1–11].

In this article, we argue that restriction of the use of the term 'emotion' to subjective experiences, and use of other terminology to describe objective responses that are often correlated with emotional experiences would eliminate much of the conceptual confusion. In making this case, we discuss several different conceptual approaches to subjective emotional experiences and the brain circuits proposed to underlie such experiences in these approaches. Because the emotion *fear* has been studied more than other emotions, especially in relation to brain circuits, and has been the center of much of the controversy about the nature of subjectively experienced emotion, we focus on it in our discussion. Because the argument made in this article applies to both fear and anxiety, we will not distinguish these two terms (for a discussion of the difference see [6]).

Measuring subjective experiences

Before considering different approaches to subjective experiences, it is important to discuss how these unobservable private events are studied. Scientific assessments of inner experiences require some form of self-reporting [12,13]. People can typically give either a verbal or a nonverbal report of information to which they have introspective access, but cannot provide a verbal report of information that is only processed nonconsciously [6,14,15]. Fractures between conscious and nonconscious processes by differences between verbal and non-verbal responses have thus played a key role in studies of introspective awareness in humans. While other methods of reporting that do not require verbal report have been proposed [16–18], these also depend on introspection [15].

Verbal self-report remains the gold standard in studies of consciousness. It is most suitable for assessing the content of immediate experiences rather than remembered experiences [14,19] and is less useful for assessing the motivations underlying actions since these are often not consciously available and verbalizable [20,21]. Since non-verbal reporting is the only option in non-verbal (non-human) organisms, determining whether other animals have conscious, subjective experiences is difficult [6].

Contemporary views of subjective emotional experiences in relation to brain circuits

Four contemporary approaches to subjective emotional experiences in the brain, and the historical roots of each, are described below. Included are approaches in the traditions of Charles Darwin, William James, behaviorism, and cognitive psychology.

1. The Neuro-Darwinian Approach: Subjective Fear is an Innate State of Mind Inherited from Animal Ancestors. In his treatise on human and animal emotion, Darwin defined emotions as innate "states of mind" that humans have inherited from animal ancestors, and that, when aroused, cause the expression of so-called emotional behaviors [22]. This is consistent with the original 17th century use of the term emotion mentioned above. It is still the commonsense view of emotion that most people have, and also underlie Ekman's widely cited basic emotions theory [23]. A contemporary neuroscience proponent of the traditional Darwinian view is Jaak Panksepp, who views emotions as subjective feelings that emerge from a subcortical neural circuit that is highly conserved across mammals, including humans [24,25]. The circuit is centered on the amygdala and related subcortical areas [24]. In Panksepp's formulation, the amygdala circuit, when activated by a threat to well being, both gives rise to fearful feelings (subjective feelings of fear) and controls innate behaviors and supporting physiological responses that help the organism defend against harm. Cognitive elaboration of subcortical fear by higher-cortical prefrontal circuits makes possible introspection and verbal reports of fear in humans. But the core of fear is the inherited mental state arising from the subcortical circuit.

Problematic for this view is evidence suggesting that the experience of fear is not embodied in the amygdala. Specifically, studies in humans show that the amygdala can respond to threats without the person knowing the threat is present and without feeling fear, and other studies show that fear can be experienced when the amygdala is damaged [26,27]; for review see [6,7]. Also, medications can change behavioral responses to threats without changing subjective feelings of fear [28,29]. Thus, while the amygdala controls behavioral responses to threats it does not seem to be directly responsible for the subjective experience of fear. One could argue that perhaps other subcortical areas are responsible. But the emphasis in the literature has been on the amygdala. Moreover, the other hypothetical subcortical circuits would need to be identified before the role can be evaluated.

2. The Neuro-Jamesian Approach: Subjective Fear is a Consequence of Feedback from Body Responses. William James famously argued that fear and other emotional experiences result by way of feedback from the act of responding [30]. Thus, contrary to the commonsense view, fear does not cause the responses but instead results as a consequence of the responses. Modern versions of this theory by Antonio Damasio [31,32] and A.D. Craig [33,34] have proposed that fearful and other emotional feelings are the result of activity in body sensing circuits in the neocortex (somato-sensory and/or insula areas) that represent body states, such as those triggered when threats activate amygdala circuits. Initially, Damasio emphasized cortical body sensing circuits but more recently has emphasized brainstem circuits [32]. As in Panksepp's theory, cognitive elaboration by higher-cortical circuits allows introspection and self-reporting about these states in Damasio's theory. While these circuits clearly represent body states, convincing evidence that these representations are the main causes of emotional experiences is lacking [6]. We propose below that body feedback makes important contributions to emotional experiences, but as modulators rather than as direct causes.

3. The Neuro-Behaviorist Approach: Subjective Fear is a Folk Psychological Construct that Should be Replaced by a Scientific Explanation. In the early 20th century, behaviorists eliminated mental states from the causal chain between external stimuli and behavioral responses. However, they retained mental state terms when describing the empirical relation between stimuli and responses. For example, 'fear' was used to characterize the relation between threats and defensive behaviors [35]. With the rise of physiological approaches to behavior in the middle of the 20th century, fear became a hypothetical physiological state (central state), that connects threats with defensive behaviors [36]. The intended purpose of this approach was to satisfy the behaviorist constraint against using subjective explanations of behavior. Ultimately, the amygdala emerged as the locus of the central fear state [37,38]. The central state model has been popular in behavioral neuroscience [39–42]. Many who call upon the central state view today are ambivalent about the extent to which fear means subjective fear or a non-subjective state. But adherents of a strong version of the position argue that subjective, conscious fear is an inaccurate scientific construct that can be replaced with a more rigorous scientific notion of fear as a non-subjective state of the amygdala-centered circuits [42]. The well-known lack of correlation between verbal reports and amygdala activity in humans [43–45] is, in this view, due to the lack of access to amygdala activity by cognitive-based introspection, and hence verbal report. In short, verbal report of subjective experience is viewed as a less desirable way of assessing fear than simply measuring amygdala-controlled responses.

The mechanistic reason a threat elicits defense responses is because it activates cells and synapses in circuits that control those responses. The fear construct is superfluous in this context [6,7,28,46]. It adds conceptual baggage