

Feedback Loops in Expression and Experience: Emotion as Cause and Effect

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Abstract

We present a synthesis of ideas and findings from emotion theory, cerebral lateralisation, and control theory which suggest that feedback from behavior motivated by lateralised approach and avoidance systems results in the valence and intensity of emotion. As movement towards appetitive and away from aversive goals deviates from optimal rates, the direction and magnitude of the deviation offers an account of emotional valence. Thus, positive/negative emotion is the first derivative of distance from a goal with respect to time. In addition, the rate of change of movement, the second derivative or acceleration, relates to emotional intensity. We link aspects of this model to well-known psychological variables, and argue that emotion, cognition and behavior are deeply interdependent.

Emotions have frequently been described in terms of underlying dimensions where the primary axes are labelled valence/pleasure and arousal (see Reisenzein, 1994; Russell & Mehrabian, 1977; Schlosberg, 1954). The results of studies employing techniques such as multidimensional scaling and factor analysis have revealed remarkably similar circumplex models with specific emotion terms arranged around the edge of a two-dimensional surface. While the existence of additional dimensions continues to be debated, valence and arousal consistently appear as the most statistically and theoretically important.

Although the reliability of the two factor solution is not generally questioned, the nature of the underlying dimensions is. First, rotating the solution produces an alternative fit with the dimensions labelled positive and negative affect (Watson & Tellegen, 1985) suggesting that emotion consists of a blend of positive and negative feelings. Second, if the dimensional model of emotion is to challenge the discrete emotions model espoused mainly by Ekman and colleagues (e.g. Ekman, 1989; Ekman, 1992a; Ekman, 1992b; Ekman, 1994; Izard, 1992; Panksepp, 1992), it becomes important to demonstrate that valence and arousal have a more than statistical existence. One aim of this work is to demonstrate that valence may arise from the feedback generated by intentional (i.e. goal-directed) behavior.

A second problem facing theories of emotion is the relationship between emotion, cognition and behavior. Central to this question is the issue of causality and precedence in cognitive-emotional-behavioral systems. In considering emotion and cognition, is it cognitive appraisals which cause emotional responses, or do 'preferences need no inferences' (Zajonc, 1980)? Regarding the relationship between emotion and behavior, do we run away because we are scared, or are we scared because we run away? A second aim of this work is to demonstrate how emotion, cognition and behavior are inextricably linked through mutual cause-effect relationships.

In determining the ontological status of emotional valence we begin by examining experimental findings of asymmetric cerebral activation in positive and negative emotions. Studies have consistently shown greater left frontal activation associated with positive emotions, and greater right frontal activation with negative emotions (e.g. Davidson, 1992; Davidson, Ekman, Saron, Senulis & Friesen, 1990; Fox et al., 1995; Henriques & Davidson, 1991; Schiff & Gagliese, 1994; Schiff & Lamon, 1994). The pleasure dimension may therefore correspond with momentary levels of frontal activation.

Although these results seem convincing, they are based on a limited sample of emotions, notably fear, disgust and joy. We note the ambiguity in the literature as to whether the left/right hemisphere distinction is one based on valence, or the nature of the approach and avoidance behavior associated with emotion (Davidson et al., 1990; Wheeler, Davidson & Tomarken, 1993). Both fear and disgust are negative emotions associated with motivation to avoid whereas joy is a positive emotion associated with approach. While the association between positive emotions and approach behavior and negative emotions and avoidance is strong, there is no one-to-one correspondence. Anger is an example of a negative emotion which frequently involves approach behavior and which has recently been shown to be associated with greater relative left frontal activation (Harmon-Jones & Allen, 1998).

Carver & Scheier (1990), adopting a control theory approach, argue that satisfaction, and hence emotion, can be modelled as the output of a system designed to reduce distance to a goal. Through negative feedback the system acts to maintain the rate of approach at some optimal value. When the actual rate falls below this, negative emotion is experienced and restorative action initiated which directs resources towards attaining the goal. When progress is greater than required, positive emotion occurs and triggers behavior redirecting resources away from the goal. There is some evidence which suggests outcome satisfaction is related to average rate of approach { ADDIN } (Hsee & Abelson, 1991; Hsee, Salovey & Abelson, 1994).

The proposed model offers an account of the relationship between emotional valence and behavior, embraces the notion of emotional intentionality, and provides an explanation for the transitory nature of emotion. Emotions concern goal-directed activity in the context of a homeostatic system acting to motivate behaviors that remove the cause of the emotion. Emotional valence is therefore both cause and effect of intentional behavior.

In addition to modelling emotional valence, we argue that the second derivative of distance, acceleration, is a candidate for emotional intensity. The intensity of good and bad feelings depends not on the rate of progress, but on the rate at which this changes. We suggest that the optimal level for this variable is generally zero.

Although the scheme as proposed is incomplete, its formality makes it capable of rigorous investigation. Furthermore, several features of the model can be mapped onto areas of psychological theory. For instance, error sensitivity (the degree to which restorative behavior is motivated by discrepancies between actual and ideal values) maps closely onto neuroticism, and the rate at which sampling occurs may directly affect the degree of fluctuation in the system, its 'moodiness'.

We conclude by arguing that the control theory approach circumvents the Zajonc-Lazarus precedence debate by illustrating the inextricable circularity of emotion, cognition and behavior. Emotion, at least in terms of valence and intensity, arises as a direct result of behavior, but then acts to modify that behavior through perception and inference. None of these systems can act in isolation from the others.

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