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Comment: Old Wine in New Bags—Suri and Gross's Connectionist Theory of Emotion is Another Type of Network Theory

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Abstract

Suri and Gross's 2022 connectionist emotion theory can be considered as one version of a family of theories known as network theories of emotion. It presents similarities and differences with older versions of network theories. Like previous network theories and several other traditional emotion theories, however, the connectionist theory remains a reactive theory. The class of reactive theories can be meaningfully contrasted with a class of instrumental theories of which the goal-directed theory is a representative example. Although the latter theory does not deny the existence of emotion networks in memory, it does not grant them many causal powers, thereby seriously restricting their explanatory territory. Future research efforts may help disambiguate between both classes of theories.

Keywords
network theory, goal-directed theory, emotion theory

The emotion domain is dominated by four families of psychological theories that each propose their own mechanism for emotion causation: evolutionary theories (a.k.a affect program theories or basic emotion theories), network theories, appraisal theories, and psychological constructionist theories (Moors, 2009, 2022). I focus here on the first three. Modern interpretations of these theories share the idea that emotional episodes comprise cognitive, motivational, somatic, behavioral, and experiential components. The main source of disagreement lies in the mechanisms that they propose as causing and/or underlying the phenomena residing in these emotional episodes. But there is also substantial overlap.

Evolutionary theories propose that a limited number of basic emotions is generated or subserved by a particular affect program. An affect program can be understood as an innate association between (a) the representation of a particular type of stimulus (S), which constitutes a challenge or opportunity for the organism's survival or thriving, and (b) the representation of a particular type of behavior or response, which is in fact an action tendency (R). In some theories, these S–R associations are formulated at a concrete level, such as "snake-flight". In others, they are formulated at an abstract level, such as "danger-defense". In the concrete case, the S–R connection is preceded by a perceptual process that registers the concrete features of the stimulus, such as that it is curved, slippery, and has sharp teeth. In the abstract case, the S–R connection is preceded by a evaluation process that processes abstract features of the stimulus, such as that it is dangerous, or at a finer granular level, that it is incongruent with one's goal for safety and difficult to control. The evaluation process is borrowed from appraisal theories where it is dubbed an appraisal process.

Appraisal theories put this appraisal process center stage. They consider it as the start for most emotions and as the main determinant of the quality and intensity of these emotions. But also in appraisal theories, the appraisal process needs to be translated into the other components. In the biological version of appraisal theories, patterns of molecular appraisal values (e.g., goal-relevant, goal-incongruent, unexpected, difficult to control) are first summarized in a molar appraisal value (e.g., danger) before the latter value is taken as the input of an abstract S–R association or affect program (e.g., danger-defense), just like in abstract evolutionary theories. In the non-biological version, on the other hand, S–R links are also doing the work but they are cast at a lower level of analysis. Molecular appraisal values separately determine molecular values of action tendencies. For instance, goal relevance determines the intensity of the ensuing action tendency, goal in/congruence determines its direction, and controllability determines the direction of adaptation (whether the organism adapts to the stimulus or makes the stimulus adapt to the organism).

Network theories also come in a biological and a non-biological version. The biological version accepts that

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innate affect programs cause the first instances of emotions (e.g., Bower, 1981; Lang, 1985; Leventhal, 1984). The affect program for fear causes the first instance of fear, that of anger the first instance of anger, that of sadness the first instance of sadness, and so on. Once an emotion has occurred, representations of the stimulus and of all of the emotion's components are formed and stored in memory. Based on the Hebbian principle that what fires together wires together, the representations get connected in the form of a network in which the nodes stand for the representations. From then on, the occurrence of the same or a similar stimulus or of each of the emotion's components is sufficient to activate the network. The activation spreads from one node to the others provided that thresholds are surpassed. Thus, emotions can be elicited from the stimulus side, by encountering a similar stimulus as the one that was represented, but also from the response side, for instance, by taking drugs, putting on a happy face, or acting aggressively. Emotion network are progressively elaborated and refined by subsequent learning processes. As a result, emotions become more varied across individuals as life progresses.

In my description of them so far, biological network theories do not differ from evolutionary theories, since all evolutionary theories have long accepted that innate mechanisms are supplemented and refined by learning processes. The crucial difference between the two theoretical families is that evolutionary theories consider the innate part of emotions to be the "pure" emotion whereas network theories consider the innate and learned parts of the entire network to be equally emotional (Leventhal, 1984).

Despite the role attached to learning processes, biological network theories believe that networks remain organized around the initial affect programs that are given at birth. This is different for the non-biological version of network theories (e.g., Colombetti, 2009; Lewis, 2005). Proponents of the latter version hold that emotions are not, or no longer, organized around affect programs, but are emergent products of interacting nodes. This view aligns well with recent psychometric network approaches to emotion in which the notion of emotion as the common latent cause of all components is rejected and in which the mutual interactions among the components are seen as a sufficient basis for the emergence of emotion (e.g., Lange et al., 2020).

The connectionist theory of emotions proposed by Suri and Gross (2022)—the Interactive Activation and Competition framework for Emotion (IAC-E)—can be said to fit in the broad family of network theories. This conclusion can be drawn based on striking similarities, such as the idea that emotions are networks of nodes (standing for representations of stimuli, emotional components, and other information), the idea that networks get expanded and refined through learning, that networks can be activated via the stimulus side (passing through appraisal) but also from the response side (circumventing appraisal), and the idea that associative operations are the only ones that are allowed to act. Moreover, since the IAC-E does not eschew innate S–R connections as the foundation of emotions, the theory can be classified as a biological version of network theories.

Besides these commonalities, the IAC-E also presents a number of real and apparent differences compared to prior network theories. A first difference is that the associative operations in the IAC-E can be either excitatory or inhibitory. A second difference is that the IAC-E postulates the existence of hidden units. Suri and Gross (2022) argue that hidden units are essential to account for the interactivity between the nodes and especially their flexibility and context-dependence, but prior network theories could handle interactivity, flexibility, and context-dependence without hidden units. A third—apparent—difference is that networks do not seem to be organized around basic emotions, as is the case in other biological network theories. On closer consideration, however, the hidden units figuring in the simulations of empirical phenomena carried out by the authors (i.e., Simulation #1, Simulation #2) correspond to basic emotions terms. The fact that all components project on these hidden emotion nodes is equivalent to the idea of having a separate emotion network for each basic emotion. The choice to groups the nodes in the network not according to basic emotions (one for fear, one for anger, one for sadness, etc.) but rather according to the nature of the nodes (one layer for stimuli, one layer for each of the emotional components, one layer for hidden units) has the advantage, however, that it spells out how the notion of competition between the networks of different emotions can be implemented. While previous network theories already voiced the idea that the networks of different emotions compete and that the emotion network with the highest activation level wins the competition, the IAC-E spells this out as resulting from the interplay between the excitatory links among the nodes of a different layer that belong to the same emotion and the inhibitory links between the nodes within the same layer that belong to a different emotion.

Like other network theories, evolutionary theories, and appraisal theories, the IAC-E counts as a reactive theory, that is, a theory in which emotions are governed by (concrete or abstract) S–R links, even if these S–R links can be activated both from the stimulus side (S) or from the response side (R). This aligns with Suri and Gross's (2022) statement that associative operations are the only currency in this theory. Reactive theories stand in sharp contrast to another class of emotion theories, which can be called instrumental theories. One recent example of such a theory is my own goal-directed theory (Moors, 2017a, 2017b, 2022; Moors et al., 2017). Here stimuli (actual or anticipated states) are first compared to goals (desired states) and the detection of discrepancies with one or more of these goals activates the goal to reduce these discrepancies via one of three broad strategies: overt behavior (i.e., assimilation), replace some of the first goals (i.e., accommodation), and reinterpret the stimulus so that it appears less discrepant (i.e., immunization). If the strategy of overt behavior is chosen, the organism

still needs to select a more concrete action option from its repertoire. Both the choice of a broad strategy and the choice of more concrete action option are done based on the weighing of the expected utilities of the strategies and action options available in the organisms' repertoire. Once an action option is chosen, it activates its corresponding action tendency, leading in turn to somatic responses and overt behavior. Experience, in this theory, is the reflection of all other components in consciousness.

The goal-directed theory does not go so far as to exclude the existence of S–R and other associations, but it grants it very little power. It accepts that associations will be formed among all sorts of representations and that the connection weights of these associations will continuously be reshaped. Yet the theory assumes that even if these associations compete with goal-directed processes, they will almost never be powerful enough to override constantly active goal-directed processes. The result is that most of our behavior, including the behavior that people tend to classify as emotional behavior will most often be generated by goal-directed processes instead of S–R or other associations that do not contain any information about the outcomes of the behavior.

Emotion scholars face the task of identifying differences and similarities among the myriad of emotion theories currently populating the emotion domain. Once the differences are sharp, empirical research can be set up to test competing hypotheses. Suri and Gross (2022) have shown how the IAC-E can be put to work by presenting a number of simulation exercises. They also argue that the IAC-E is falsifiable. They argue that interactivity between the nodes cannot hold in the absence of hidden units and that consistency depends on populations of nodes with strong connection weights. Very little is said about what type of empirical research would count as a falsification of these assumptions, and the confirmation of these assumptions seems to be compatible with a host of other theories and assumptions. But the real research that is required, in my opinion, is to test whether the phenomena that people call emotions are undergirded by networks of associations among components built around innate or learned S–R connections or whether they are caused by goal-directed processes of the kind proposed in the goal-directed theory (see Moors & Fischer, 2019).

Finally, Suri and Gross (2022) state that the IAC-E is agnostic about the components that figure in emotions, the degree of consistency that exists among the components of individual basic emotions, and the degree of appraisal-based instances of emotions. It seems, however, that the theory is also agnostic about which instances count as emotions, unless we must interpret the presence of a hidden unit that matches a basic emotion as the sine qua non of emotions. If this is also "just an example" and not a theoretical commitment, the theory leaves us in the dark as to how emotional episodes differ from non-emotional ones. This raises the question whether and in what sense the IAC-E is an emotion theory at all and hence whether the question "What is an emotion" has really been addressed in the target paper.

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