

Three-tier Model of Emotions

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Introduction

Models of appraisal theory have been continuously developing for the past 3 decades, much stemming from the popular and influential model developed by Ortony, Clore, and Collins (OCC) (Ortony, Clore, & Collins, 1990). When Picard published *Affective Computing*, it marked the birth of computational models of affect (2000). The past decade and a half have had numerous examples of applying computational models of appraisal for a variety of autonomous agents (e.g. (Becker-Asano & Wachsmuth, 2009; Gratch & Marsella, 2004; Marinier, Laird, & Lewis, 2009; Rosis, Pelachaud, Poggi, Carofiglio, & Carolis, 2003)). These agent and other embodied conversational agents have been demonstrated in domains, including intelligent tutors, game players, and real estate agents. Some work has not been specific to a particular domain but has focused on developing realistic emotion behavior (Breazeal, Buchsbaum, Gray, Gatenby, & Blumberg, 2005; Rosis et al., 2003). Creating an agent to recognize emotions or behave with realistic emotions does not require accurate models of emotion. It is sufficient for these systems to implement well-defined rules relating emotions to observable characteristics and features of emotions. The models do not take into account the development of emotions or how emotions arise, how they are learned, or explain irregular emotional behavior. A more complete model of emotions needs to account for the conscious appraisal of a situation, learned affective reactions, and innate affective behaviors and relate these three layers of emotions. In order for computational models of emotion to be beneficial to psychotherapy, all three layers must be incorporated. The source of the emotional behavior may stem from any level. We will briefly describe here the role of these levels in psychotherapy and give examples of models, where available.

Models of Appraisal and Reaction

A conscious deliberation of a situation and appraising it is the basis of emotion models based on appraisal theory. These models have been valuable for characterizing and classifying emotions (OCC) and have been influential in designing affective displays of emotion. These conscious appraisals of emotions are not the source of emotional disorders, but they stand as the baseline to which to compare the emotions felt by an individual. The EMA model, based on OCC and Lazarus (Lazarus, 1991), would classify a feeling of hope when there is some likelihood of an event that is between 0.0 and 1.0 and the event is desirable (Gratch & Marsella, 2004; Marsella

& Gratch, 2006). This explains the expected response to an event, but it does not explain why a person may feel unhappy in this scenario instead. Fear or sadness require an undesirable event, but if the person is consciously aware that the event is desirable but still feels fear then this model fails to explain the emotion felt by the individual.

Many emotions are not based on a logical explanation of the scenario but instead are learned. Experiences provide feedback that become associated with the situation so that when a future situation occurs that bears similarity, the resulting behavior is influenced by the memory of the previous situation (Baumeister, Vohs, DeWall, & Zhang, 2007). Combining these learned emotions as affective reactions with a conscious appraisal of the scenario was demonstrated in a computational model in which the automated agent learned how to react to steps in solving physics problem (Wilson, Forbus, & McLure, 2013). This model as well as the one demonstrated in the WASABI system make a distinction between emotions that are a reaction to the scenario from the emotions that are part of a cognitive appraisal. In both of these systems, the affective reaction is first, before cognitive processing of the situation. This is compatible with Zajonc's "primacy of affect" that requires affect to (at least partially) precede conscious evaluation (Zajonc, 1980).

These models have the potential of explaining emotions that are learned or based on experience. The intensity of the emotion that arises from the affective reaction may trump any cognitive appraisal of the situation. This can be seen in many cases of OCD and PTSD. It also explains some of the therapeutic strategies of CBT to create new memories with less intensity associated with the stimulus. However, it does not account for failures of CBT or when the emotional behavior is not based on memories or experiences. Additionally, it does not account for the role of neurochemical transmitters. I will focus on a particular case study in which CBT has had almost no success and psychopharmacology has had limited positive influence.

Case Study

A brief case study will illuminate these deficiencies and the need for an additional layer to the model. MC is a 22 year old female. She was first treated for depression at the age of 12 after incidents of self-injury. She had not experienced any trauma or abuse. Treatment included CBT and psychopharmacology. At the age of 17, she became suicidal, had increased social anxiety, and obsessive and compulsive behaviors had become a significant problem. OCD symptoms include germophobia, trichotillomania, and hoarding. While much of the OCD behavior is learned in the sense that once it

begins it acts as a reinforcement of the behavior, there was no initial incident from which the behavior stemmed. One behavior that has been increasing lately is insatiable searching. This greatly affects her school work in that she cannot stop searching for the correct or better answer. There is always one more website to check or one more parameter to try. She is consciously aware that she is obsessing, and she has numerous experiences in which the answers she finds are correct and sufficient. These memories and the conscious awareness cannot aid her in feeling satisfied. Instead, she feels compelled to keep searching.

Clearly, models of emotion that rely on purely a cognitive appraisal are not sufficient for explaining the feelings experienced by MC. Additionally, models of reactionary emotions that rely on memories as feedback only partially explain the behavior of MC. These models do not provide an explanation for the origin of her feelings or how this feeling is overwhelming all emotions based on memory or conscious thought. It is necessary to include a third layer to the model, a most basic layer that is founded in the innate emotional behaviors of all mammals. With the addition of this third layer, the model resembles the three sets of processes (primary, secondary, and tertiary) described by Panksepp (Panksepp, 1998). He focuses on the primary processes, of which he has identified seven: SEEKING, REAR, RAGE, LUST, CARE, PANIC, PLAY (capitalization is to be consistent with usage by Panksepp). The SEEKING system is of interest in our case study. This insatiable searching is similar to the behavior of rats that incessantly press a lever to be self-stimulated (Panksepp, 1998). The self-stimulation is triggering the reward system in the SEEKING process. The rats quickly identify the source of the reward and will self-stimulate until exhaustion.

The SEEKING process is perhaps the most basic process. It is the innate mechanism that motivates foraging and exploring of the environment to find resources. This process of seeking and exploring is rewarded and feeds into mechanisms for reinforcement learning. It is this reward, this satisfaction, that the rats cannot stop desiring. Similarly, MC craves this satisfaction and will not stop craving it. The SEEKING system has previously been linked to emotional disorders such as obsessive compulsive and paranoid schizophrenia (Panksepp, 2001). This case study serves as an example for the relation between OCD and the SEEKING system. Additionally, it is clear from this case study that a complete model of her emotions and behavior must include a model of the SEEKING system.

Conclusion

A three-tier model of emotions is necessary to create a complete explanation of emotions and behavior. The case study with MC has demonstrated some of the deficiencies in models that rely on cognitive appraisal or learned emotions. We do not propose that this three-tier model is complete. The relations between the layers is not yet defined. Also, there

are many other aspects not included, from natural language to somatic responses. The intent of this work is to highlight that a model of emotions, particularly if used in psychotherapy, must at least incorporate emotions originating from innate mechanisms, memories, and higher-level cognition.

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