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Émile: Marshalling Passions in Training and Education

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ABSTRACT

Emotional reasoning can be an important contribution to automated tutoring and training systems. This paper describes Émile, a model of emotional reasoning that builds upon existing approaches and significantly generalizes and extends their capabilities. The main contribution is to show how an explicit planning model allows a more general treatment of several stages of the reasoning process. The model supports educational applications by allowing agents to appraise the emotional significance of events as they relate to students' (or their own) plans and goals, model and predict the emotional state of others, and alter behavior accordingly.

1 INTRODUCTION

Emotional computers may seem an oxymoron but recent years have seen a flurry of computation accounts of emotion in a variety of applications. This paper describes Émile, a model of emotional reasoning that extends and significantly generalizes prior work. Émile illustrates how an explicit planning model supports a more general treatment of emotional reasoning (specifically with respect to 'prospective' emotions, the treatment of inter-agent interactions, the derivation of emotional intensity, and management of the dynamics of emotional expression). The model allows agents to appraise the emotional significance of events as they relate to plans and goals, model and predict the emotional state of other agents, and alter behavior accordingly. Émile is particularly suited to applications where agents must plan as well as react (as in Rickel and Johnson, 1998; Hill *et al.*, 1997; Pell *et al.*, 1998).

But why model emotion? Emotions have received the most attention for their strength in creating engaging and believable characters in entertainment and art. Though somewhat less obvious, emotional reasoning can play a key role in educational tools. Psychological and neuroscience research indicates that emotions have a powerful influence on human behavior, both through their use as a non-verbal communication channel (Oatley and Johnson-Laird, 1987) and through their sway over planning and action selection (de Souza, 1987; Damasio, 1994). Recent work on tutoring systems has begun to address the communicative function by, for example, making tutoring systems respond to a student's emotional 'language' and generating emotion cues during instruction (Lester *et al.*, 1999; Johnson *et al.*, 2000). Research into military training simulators has also begun to address the influence of emotions on behavior (Hudlicka and Billingsley, 1999). Indeed, a panel of the National Research Council conducted a survey of this topic and concluded that the lack of "behavioral moderators" such as emotion substantially limits the capabilities of existing military simulations (NRC, 1998), leading, in part, to the creation of a new research institute to investigate such issues.[1]

This article takes as given that modeling affect is important, and sets forth one proposal for how this might be accomplished in the context of dynamic, interactive, and non-scripted training environments. The goal is to create autonomous agents that populate so-called "constructive simulations" where the trajectory of a training exercise arises from the interactions between participants (real or synthetic). This imposes strong requirements on the emotional models. Agents must automatically appraise the environment, derive a plausible emotional state, and modulate their behavior accordingly. Training simulations place other requirements that differ from entertainment-oriented applications. On one hand, the focus is more constrained as one only needs to model typical human behavior, not Micky Mouse as well, and not the richness of character necessary for entertainment applications. On the other hand, as the goal is to create operational systems, there is more need for generality, scalability, and the ability to support the constant flux in equipment and tactics.

Émile builds on prior computational models of emotion, notably Neal Reilly's (1996) Em algorithm and Clark Elliott's (1992) Affective Reasoner. Like many models it traces its lineage back to the influential theory proposed by Ortony, Clore, and Collins (1988). Émile differs in emphasizing the role of plans in emotional reasoning, and thus draws significantly on the work of Lazarus (1991), Oatley and Johnson-Laird (1987), Sloman (1987) and Beaudoin (1995). As with Sloman, Beaudoin, and Neal Reilly, my focus is on understanding the interaction of emotion, decision-making and action selection (so-called "broad-agents"). I therefore describe emotional reasoning in the context of other forms of reasoning: the overall system addresses the issues of how to develop and execute plans to achieve goals, model the plans and emotional responses of other (human or synthetic) agents, guide the presentation of information through emotional expressions or gestures, and influence the process of plan generation and action selection.

2 PLANNING

Many psychological theories of emotion emphasize the relationship between plans and emotions. Nevertheless, the vast majority of computational approaches do not explicitly represent plans (even approaches derived from psychological theories that do). This is partly pragmatic – when they were developed, planning algorithms had a number of limitations that precluded their easy

[1] The Institute for Creative Technology: www.isi.edu/uarc.html