Toward effective emotional intelligence simulation: Modeling understanding ability for emotive agents

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The ability to understand the emotions of others is critical for successful interactions among humans (Dias & Paiva, 2009; Kazemifard, Ghasem-Aghaee, & Ören, 2010). The psychological theory of emotional intelligence (EI) proposes four categories of relevant abilities (Mayer & Salovey, 1997): (1) identifying emotions, (2) understanding emotions, (3) using emotions in thought processes, and (4) managing emotions. This research focuses on emotion understanding, the cognitive activity of making inferences using emotional knowledge about why an agent is in an emotional state (e.g., unfair treatment makes an individual angry) and which actions are associated with the emotional state (e.g., an angry individual attacks others). Such emotion understanding in humans develops through their experiences with other agents. How might such learning in humans inform a model to enable artificial emotional agents to develop emotion understanding? Our approach to answering this question proposes a model of emotion understanding that combines psychological theories of episodic and semantic memory with the rich paradigm of machine understanding. Specifically, our model has five components. (1) Episodic memory (Tulving, 1983) stores details of specific events. (2) Semantic memory (Solms & Turnbull, 2003) stores "general knowledge," such as the similarity of emotions. (3) Semantic graphs are semantic networks that can learn and represent relationships among emotions and actions stored in episodic memory (we conceptualized these as adding to semantic memory). (4) A perceptual mechanism assigns agents to types (or groups) with similar goals. (5) A memory modulator integrates results of episodic memory and semantic memory. We used the memory modulator to selectively "lesion" the different kinds of memory in order to evaluate how the different kinds of memory helped our simulated agents achieve their goal: to manipulate the emotions of other agents.The simulation was a multi-agent system in which agents select actions with the goal of eliciting a target emotion in other agents. If successful, an agent gets a reward; otherwise it gets a punishment. We ran simulation in the Java Agent DEvelopment Framework. We implemented our model atop Soar since it includes both episodic memory (Nuxoll, 2007; Nuxoll & Laird, 2004, 2007) and semantic memory (Wang & Laird, 2006). The agents started without knowledge of the emotional reactions of other agents or themselves, but each had 12 emotions and 14 actions available to them. They collected emotion knowledge during their interaction with other agents. Using the memory modulator, we evaluated three configurations of memory abilities: (1) Agents with only episodic memory, (2) Agents with both episodic memory and semantic memory, and (3) Agents with episodic memory, semantic memory, and semantic graphs. For each configuration, we did 15 runs of the simulation, with 20 agents and 40 ticks per run. We compared the configurations on accuracy, the percentage of all actions of agents that the focal agents recognized appropriately. Agents with only episodic memory (27.5% accuracy) were less accurate than agents with both episodic and semantic memory (39.5%). Agents with all three types of memory (41%), however, had the best performance. The main contribution of this paper is an elaboration of a model in which emotive artificial agents improve their emotion understanding ability by interacting with other emotional agents, thus increasing the effectiveness of their emotional intelligence. Our proposed model of emotion understanding ability for emotive agents elaborates on our previous research on the topic (Kazemifard, Ghasem-Aghaee, & Ören, 2009) and tailors the general model of machine understanding to understand emotions. We note the limitation that our agents had only reactive behavior. In our future work, we aim to enable agents to anticipate the emotions of other agents.

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