

Chapter 5.7

Emotional Memory and Adaptive Personalities

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ABSTRACT

Believable agents designed for long-term interaction with human users need to adapt to them in a way which appears emotionally plausible while maintaining a consistent personality. For short-term interactions in restricted environments, scripting and state machine techniques can create agents with emotion and personality, but these methods are labor intensive, hard to extend, and brittle in new environments. Fortunately, research in memory, emotion and personality in humans and animals points to a solution to this problem. Emotions focus an animal's attention on things it needs to care about, and strong emotions trigger enhanced formation of memory, enabling the ani-

mal to adapt its emotional response to the objects and situations in its environment. In humans this process becomes reflective: emotional stress or frustration can trigger re-evaluating past behavior with respect to personal standards, which in turn can lead to setting new strategies or goals. To aid the authoring of adaptive agents, we present an artificial intelligence model inspired by these psychological results in which an emotion model triggers case-based emotional preference learning and behavioral adaptation guided by personality models. Our tests of this model on robot pets and embodied characters show that emotional adaptation can extend the range and increase the behavioral sophistication of an agent without the need for authoring additional hand-crafted behaviors.

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INTRODUCTION

When we see a pet we've met before, we recall not just its name and temperament but how our interactions with it made us feel. We feel happy when we see the dog we had fun playing with, and feel sour about the cat that shocked us with its hiss. And just as we learn from them, they learn from us; the dog, remembering its happiness upon playing with us, may seek us out when we are down; and the cat, remembering our shocked reaction when it hissed, may avoid us, or be more cautious with its anger in the future. Pets don't need to be 'configured' to live with us, and neither do we: all we need is the ability to react emotionally to our situations, a memory for our past emotional states, and the ability to let those recalled emotions color our current emotional state and guide our behaviors appropriately. We argue that robots and synthetic characters should have the same ability to interpret their interactions with us, to remember these interactions, and to recall them appropriately as a guide for future behaviors, and we present a working model of how this can be achieved.

Of course, humans are more complicated than pets; we have not just emotions but also ideals for our behavior, and can modify our reactions and plans when they violate our ideals. We may snarl back at the hissing cat, but that outburst of emotion can make us reconsider when we should show anger. Even if we do not reconsider at first, if we see the same cat multiple times we may eventually be prompted to figure out why it continues to try to enter our new home, to realize it was probably abandoned, and to change our routines to leave food for it – turning a hissing cat into a new companion. It may seem a tall order make robots have this kind of flexibility – but we argue it is possible by using emotion to trigger behavior revision guided by a personality model, and we present a working model of how it can be achieved.

In this chapter, we review efforts to build agents with believable personalities, point out problems

particular to making these personalities convincing over long-term interactions with human users, and discuss research in cognitive science into the mechanisms of memory, emotion, and personality. Based on these psychological results, we present a method for building believable agents that uses emotion and memory to adapt an agent's personality over time. We then present two case studies illustrating this idea, the first demonstrating emotional long term memory in a robot, and the second demonstrating emotion-driven behavioral updates in an embodied character. Finally, we conclude with lessons learned.

BACKGROUND

What Kind of Agents Need Memory, Emotion, and Personality Models?

In our work we are interested in affective systems: robots and agents designed to display, respond to, or make use of emotional states, in particular those which interact with humans over a long period of time in relatively unconstrained settings. Research into what makes characters appear believable indicates that changing and expressing emotion are key to maintaining believability over time (Loyall, 1997). We argue that using explicit emotion models integrated into an agent's memory but guided by the agent's personality model can aid the development of agents for long term interaction; to explain why, we will briefly review some popular techniques for creating believable agents and some typical problems that can arise.

Techniques for Creating Agent Personalities

Entertainment robots and embodied characters typically are designed to have distinctive personalities which affect how they behave towards their human user or how they act within the virtual world of a game. At first blush, such agents do

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