Episodic Memory Retrieval Through Re-appraisal of Past Events

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Ortony proposed that for an agent to be believable it is necessary that its emotions, actions and motivations are coherent over long time periods [3]. We believe that the absence of past personal experiences retrieval in agents may hinder the just described coherence over long time periods. Such memories that refer to personal experiences, and are linked with a specific time and place, are in psychology literature named as episodic memories [4].

In order to build agents that exhibit coherent behavior over long time periods, we have developed a model for agent episodic memory retrieval (see Fig. 1). Retrieval is a two step process, as proposed in [5] for humans: Ecphory and Recollective Experience.



Fig. 1. Episodic Memory Retrieval

In Ecphory, memory traces (episodic memories) are correlated with retrieval cues. Each memory trace refers to an event previously perceived by the agent, and contains the stimuli perceived by the agent during that event (memory trace's stimuli). We describe a group of retrieval cues, as well as memory traces' stimuli, as points in a generic perception feature space S (in analogy with Atteneave's work [1]). The correlation between a memory trace and a group of retrieval cues is defined trough a generic distance function d. The distance function should measure the difference between the current perceived stimuli (retrieval cues) and the stimuli perceived when the trace's past event took place.

^{*} Originally published in the Supplementary Materials of the 10th International Conference on Intelligent Virtual Agents.

Consider R_{rm} as the event of a memory trace m being selected for recollective experience due to a group of retrieval cues r. We propose that R_{rm} can be considered a random variable with distribution dependent on the calculated distance. Using a probability density function f similar to the half-normal, we attribute a high probability for R_{rm} occurring if the distance is small, and low probability of R_{rm} occurring if the distance is large. Consequently memory traces that have a high correlation with retrieval cues will have a high tendency to be selected and fed to recollective experience. We propose a location ecphory approximation, in which locations serve as indirect retrieval cues for memory retrieval. The motivating idea is that if place has not changed significantly, the perceived stimuli during storage of an event, and the perceived stimuli when revisiting that place, will be similar.

In Recollective Experience (RE), the memory traces' events are re-appraised. This approach was inspired by Tulving's work [4] in which it is stated that episodic memory retrieval enables a person to re-experience a past event. We defined an agent's experience of an event as the appraisal of that event. Consequently the RE is an appraisal system such as the one in [2]. Different appraisal systems have different criterion for appraising events (goal structure, frames, decision trees,...). Our proposal is that if a appraisal system is to be adapted for RE, when evaluating a past event the current criterion of the agent should be used. Consequently, a memory trace, besides the stimuli, should have all relevant information of the past event necessary for its appraisal with the chosen appraisal system.

We implemented the described model with the location ecphory approximation, adapted the reactive appraisal of [2] for the RE, and integrated the resulting architecture with a simulator oriented for an action video-game. We created a test scenario using recordings from our simulator running. We then used the recorded videos to do a preliminary evaluation of the model. The analysis of the data seems to support our hypothesis that modelling episodic memory retrieval using our architecture can positively influence agent believability. However, further tests need to be made with interactive scenarios.

Acknowledgments The research leading to these results has received funding from European Community's Seventh Framework Program (FP7/2007-2013) under grant agreement n° 215554, FCT (INESC-ID multiannual funding) through the PIDDAC Program funds.

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