

# Affective Learning Companions

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**Abstract.** Developing learning experiences that facilitate self-actualization and creativity is among the most important goals of our society in preparation for the future. To facilitate deep understanding of a new concept -- to facilitate learning -- learners must have the opportunity to develop multiple and flexible perspectives. The process of becoming an expert involves failure, understanding failure, and the motivation to move onward. Meta-cognitive awareness and personal strategies can play a role in developing an individual's ability to persevere through failure and combat other diluting influences. This thesis will center upon the development of a theory for using affective sensing and appropriate relational agent interactions to support learning and meta-cognitive strategies for perseverance through failure.

## 1 Introduction

The objective of this thesis will be to improve learners' response to failure. Failure is important to learning and instrumental to the development of multiple points of view required for deep understanding. Failure and repeated failure can also have a negative impact on motivation, affect, and learning. Therefore, learners' response to failure is very important to their continued learning. The role of failure in learning and the use of thinking and technological strategies to support perseverance through failure will be the focus of this thesis.

## 2 Affect and Metacognition

Isen has found overwhelming evidence that mild positive affect improves negotiation processes and outcomes; promotes generosity and social responsibility; self-efficacy; motivation toward accomplishment; openness and flexible manipulation of new information. "Positive affect is a source of human strength... promoting thinking that is not only efficient, but also careful, open-minded and thorough." (Isen, 2002) Learning technologies should monitor affect and consider promoting positive affect particularly at times of great challenge. It is important to realize that the staying

ticularly at times of great challenge. It is important to realize that the staying power of negative affect tends to outweigh the more transient experience of positive affect. This is a phenomenon known as “negative asymmetry.”(Giuseppe, Brass, 2003) Unfortunately for the purposes of motivating learners this negative asymmetry means that negative affect experienced from failure will persist disproportionately to the positive affect experienced from success. Educators and innovators must try extra hard to create motivating learning environments which celebrate achievement and provide sustaining inquiry opportunity at times of failure.

### **3 Virtual Learning Companions**

Learning relationships have been shown to be effective in many situations: they help learners to develop responsibility, and increase the belief in children’s ability for mastery; caring relationships and volunteering have also been shown to be predictors of performance (Tudge, Caruso, 1988; Strain, 1981; Webb, 1987). Embodied Relational Agents are capable of: developing trusting and beneficial relationships with humans; sharing combined physical and virtual space with children; and helping children develop literacy skills (Bickmore, 2003; Ryokai, Vaucelle, Cassell, 2003). This thesis will advance Relational Agents research through the development of affective virtual friends, peers, or Learning Companions. It will focus on developing a system coupling knowledge of the task a child is facing with awareness of his or her affective state and interacting beneficially. It has been argued that being attuned to the child’s emotional state through affective sensing will be important to the development of Intelligent Tutoring Systems and Learning Companions (Adcock, Van Eck, 2003; Conati, 2002).

### **4 Methodology**

To interact with a learner the Learning Companion Architecture must be able to sense the world and have an effect on it (Figure 1). The Learning Companion Architecture’s affective sensors may include cameras for facial expression and eye gaze detection, seat pressure pads to detect posture, and galvanic skin response, and game state of the disks. The hypothesis is that a Learning Companion Architecture with the ability to sense the child’s affect will have a greater impact toward learning than one that lacks this ability. This research proposes to test this hypothesis through experiments that use the Towers of Hanoi activity as the learning setting. The Towers of Hanoi is an engaging and challenging puzzle that has been the subject of considerable mathematical and psychological study (Lock, et al., 2002). A principle benefit of the choice of the Towers of Hanoi as a learning scenario is that it is recursive -- a procedure that includes itself and therefore is repeated for each successive operation. It therefore presents the important opportunity not only for failure and recovery but repeated failure and recovery. Repeated failure and recovery has been advocated as being fundamental to the development of deep understanding and multiple viewpoints

(Kay, 1991). In the Towers of Hanoi persevering through repeated failure, with the assistance of a Learning Companion Architecture, may result in affective awareness, thinking strategies, and learning that significantly contributes to expertise during a very few sessions.

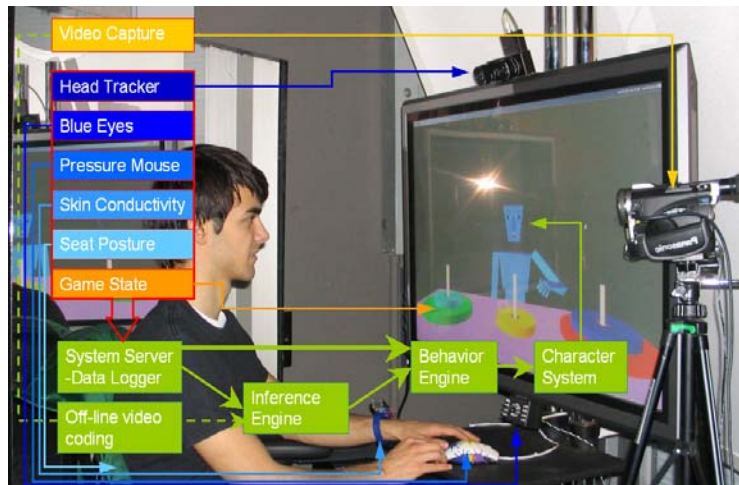


Figure 1. Learning Companion System

## 5 Experimental Design

Following qualitative assessment and pilot studies a full-scale experiment will be conducted in the methodological tradition of psychological experiments, including a control group -- interacting with Learning Companions Without Affect Sensing -- and one or more treatment groups. The primary treatment group will experience interaction with Affective Learning Companions during a preliminary learning activity. The preliminary activity is likely to be the Towers of Hanoi with five disks. Subsequent to this activity a second activity will be administered. It is likely for the second activity to be the shuffled Towers of Hanoi with five disks. T-Tests comparing the Learning Companion Without Affect Sensing group with the Affective Learning Companions group or ANOVA comparing a No Intervention group, Learning Companions Without Affect Sensing group, Affective Learning Companions group, and a human peer or teacher group will be conducted. These tests will use several of the following variable categories: overall performance on primary task; overall performance on secondary task; affect, affect transitions, and recovery from failure as sensed and/or coded in the primary and secondary task; and post-treatment assessment of personal beliefs on self-efficacy, caring relationship assessments, affect state, and intrinsic motivation.

## 6 Conclusion

This thesis will develop a theory for using affective sensing and relational agents in support of learning and to foster meta-cognitive strategies enabling perseverance through failure. It will explore how these relationships can be used to support cognitive and emotional strategies beneficial to problem solving and how imagination and celebration can be fostered for intrinsic motivation, clarity of thought, and self-actualized learning. It will also contribute to several disciplines. Within HCI it will develop new styles of user modeling, integrating multiple affective sensors into a single system, in support of learning objectives. Within the field of Learning Sciences it will quantify the effects of strategies to improve learners' perseverance through failure and the celebration of success as a means to promote positive affect and intrinsic motivation. It will extend the existing field of Computer Supported Collaborative Work to include collaboration between a learner and virtual collaborators with affective recognition and feedback on a shared learning task. This will demonstrate how a human-computer relationship can support cognitive and affective strategies for learning and motivation.

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