Text-Based Methods for Measuring Dynamic Affect in Learning Games

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Abstract
Positive affect has been shown to increase learning performance and retention. While a growing number of serious and educational games are being designed and researched, few are designed with an acute understanding of affective processes in gameplay. In this position paper, we discuss several commonly used techniques for measuring emotion and engagement in games, and recommend a methodology that accounts for affect as a dynamic system in educational games. We further discuss the preliminary analysis of text-based chat logs from a bioinformatics learning game to support our recommendations. This work has implications for the design of affective experiences in educational games and other learning environments.

Keywords: Game-based learning; serious games; affect; emotion; text analysis.

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1 Introduction

Emotion and affect have been shown to be important indicators of interest, engagement, and creativity in tasks (Fabri, 2004). Additionally, social technologies that support collaboration and peer connection can play an important role in fostering a positive youth identity (Bers, 2007). There is therefore much value in understanding the role of affective states within the framework of learning games. While the terms are frequently used interchangeably by scholars, we draw on Russ's (1993) understanding of affect as feeling states that are more inclusive and pervasive than the interrupting experience of emotions. Aragon and Williams (2011) developed a theory of collaborative creativity accounting for affect as a dynamic and complex system. We suggest that a dynamic systems model is similarly useful for understanding areas of affect-laden content measured in chat logs of educational games, and can complement existing methods of categorizing by valence (positive and negative affect states).

2 Background

Several methods of determining affect, emotion, and engagement in gameplay are commonly used. These include the measurement of physiological signals, the use of self-reported survey data, researcher observations during gameplay, and a text-based analysis of chat logs. Studies that collect physiological measures, such as electroskin conductance (e.g., Ivory, 2007) or electrocardiogram signals (e.g., Ravaja, 2006), often combine and compare these measurements with self-reported assessments of emotional state. Conati (2002) presents an approach using a Dynamic Decision Network and physiological measures to estimate players' emotional state while playing educational games. A growing body of research has also worked to automatically adapt game difficulty and state based on players' physiologically measured emotional state (e.g., Chanel, 2011; Liu, 2009). Lazzaro (2004) observed gameplay sessions to determine four areas of fun and to gain insights into associated emotions. A challenge with many of these measures is the dependence on an experimental setting for collecting this data.

There have also been several notable studies that use a text-based analysis of game chat logs to understand the affect and experience of players. Ducheneaut et al. (2006) conducted an analysis of text-based communication in World of Warcraft (WoW), noting that WoW's players utilized chat as a form of performance and for diffuse information access. In research on text chat in BZFlag, an open source capture the flag game, Herring et al. (2009) found that that messaging between players occurred at seemingly regular intervals of the same length, and that the majority of messages were related to reactions to gameplay. There have additionally been several strategies for categorizing affect in communication in games. Peña and Hancock (2006) categorized participant text messages into socio-emotional and task-based messages, finding the majority of the messages to be socioemotional and

positively valenced. While categorization by valence and task is useful, our analysis suggests there are benefits to augmenting these techniques with a more dynamic understanding of affect in learning games.

3 Methodology & Discussion

We discuss the preliminary analysis of chat logs from the bioinformatics game *MAX5,* where youth (ages 14 – 19) played the PC game within the context of a high school science class (Perry, 2013). Players were automatically and randomly paired, communicating through an in-game chat interface to complete game missions to stop the spread of a deadly flue virus. Two independent coders analyzed 171 chat messages that were sent and received in the in-game chat tool. Task-based messages contained procedural content related to accomplishing game tasks and did not contain affect. We found 53 instances of affect-laden messages either negatively or positively valenced (the joint-probability of agreement between coders was 78%). We found 69 instances of task-based messages (the joint-probability of agreement between coders was 86%). Codes in disagreement were not included in the sample. Overall there were a greater number of messages expressing negative affect than positive affect (36 negative as opposed to 19 positive messages). While the small sample size prevents us from making generalizable results, it does allow us to compare coded categories with a more qualitative content analysis. We further posit that binning by positive and negative affect and task-based messages, while helpful, does not adequately reflect the dynamic interactions we observed in the logs over time.

Task-based	user_07: I found that most of the viruses are from California, and I think I got all of the animal's DNA
Task-based	user_07: Im in the mountains now, trying to get to the building at the top
	user_07: what did you get
negative	user_08: Like I said, a dead chicken. I'm afraid I'm not terribly great at video games.
negative	user_07: I'm so lost
	user_08: I'm sorry for your loss.
positive	user_07: lol thanks?
positive	user_08: Anytime. Happy my snarky commentary can amuse you in these dark times.
negative	user_08: New low. Almost got killed by a bird.

Figure 1. A coded chat log collected from the bioinformatics game *MAX5*.

In the example above (Figure 1), a player asks for task-based information related to the game mission and an affective exchange follows this. While there are more negatively coded messages in this example than positive, the overall tone is actually quite playful and supportive in nature. This exchange mirrors a process that Aragon and Williams (2011) refer to in their collaborative creativity model as the *frame* stage, in which a sense of trust is formed and group members work "to absorb external information, data, ideas, and intellectual nourishment, and at the same time to filter out potentially harmful environment pressures." In this particular case, we observe a damping of negative affect with banter that is supportive in tone.

In this preliminary work, we suggest a dynamic model of affect applied to in-game chat logs provides a useful understanding of *how* and *why* valence is operating within a learning game. In further work, we are additionally interested in ways we can extend this analysis of dynamic states using an automated approach that is scalable to larger data sets.

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