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Quantifying engagement: Measuring player involvement in human–avatar interactions

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ABSTRACT

This research investigated the merits of using an established system for rating behavioral cues of involvement in human dyadic interactions (i.e., face-to-face conversation) to measure involvement in human–avatar interactions. Gameplay audio–video and self-report data from a Feasibility Trial and Free Choice study of an effective peer resistance skill building simulation game (DRAMA–RAMA™) were used to evaluate reliability and validity of the rating system when applied to human–avatar interactions. The Free Choice study used a revised game prototype that was altered to be more engaging. Both studies involved girls enrolled in a public middle school in Central Florida that served a predominately Hispanic (greater than 80%), low-income student population. Audio–video data were coded by two raters, trained in the rating system. Self-report data were generated using measures of perceived realism, predictability and flow administered immediately after game play. Hypotheses for reliability and validity were supported: reliability values mirrored those found in the human dyadic interaction literature. Validity was supported by factor analysis, significantly higher levels of involvement in Free Choice as compared to Feasibility Trial players, and correlations between involvement dimension sub scores and self-report measures. Results have implications for the science of both skill-training intervention research and game design.

1. Introduction

More and more computer-based simulation games are being used for teaching and training purposes in healthcare (Nehring & Lashley, 2009), school (Gee, 2005), and military (Garris, Ahlers, & Driskell, 2002; Oswalt, 1993; Smith, 2010) settings. "Digital puppetry," or the real-time animation of human-controlled virtual characters, or avatars, is a technology that can be used to create a highly interactive simulation game play experience (Norris, Hughes, Hecht, Peragallo, & Nickerson, 2013). Highly interactive games are assumed to be highly engaging (Charoenying, 2010) and thus more effective for teaching and training (Dickey, 2005; Salen & Zimmerman, 2004; Vogel et al., 2006). However, no measurement approach exists to assess the engagement properties of these games.

The purpose of this methodologic paper is to assess the reliability and validity of using Guerrero's (2005) rating system for assessing involvement in human dyadic interpersonal interactions as a measure of player involvement in the human–avatar interactions occurring in a skill-building simulation game called DRAMA–RAMA™ (Norris et al., 2013). This rating system provides an opportunity to add an objective measure to the battery of current engagement instruments that are reliant on self-report data. Towards that end, audio–video data from an early and subsequent version of the game were analyzed and used to investigate the reliability and validity of this measurement approach for capturing the involvement aspect of engagement.

2. Background

Narrative engagement theory (or NET; Miller-Day & Hecht, 2013), data regarding real-time simulation games, and game theory alternately identify aspects of effective skill-building interventions and features of successful games that can inform measurement of player engagement. NET identifies perceived realism and involvement as key aspects of engagement, and

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indicative of a game's ability to teach the player new behavioral skills.

In the context of real-time simulation games, engagement is indicated by the player's involvement in game play and the player's perception that the game play experience is real (i.e., the game play "rings true" to his or her own experiences; Lee, Hecht, Miller-Day, & Elek, 2011). Player involvement increases with the perceived behavioral realism of the avatar (Guadagno, Swinth, & Blascovich, 2011; von der Pütten, Krämer, Gratch, & Kang, 2010). The avatar's capacity to act in a realistic manner contributes to what McMahan (2003) refers to as the social realism of the virtual environment. Social realism, in combination with perceptual realism—that is, how convincing the game environment looks and sounds—helps build and sustain an overall sense of realism for the player.

Game theory identifies two characteristics as critical components of highly engaging games (Sweetser & Wyeth, 2005): (1) the absence of predictability (Koster, 2005), or the game's ability to generate surprise or mystery (Dickey, 2005; Garris et al., 2002; Salen & Zimmerman, 2004), and (2) the presence of flow, or the game's ability to create an experience where the player loses track of time (Csikszentmihalyi, 1990). Therefore, games that are perceived as predictable (Koster, 2005) or games that fail to create an optimal flow experience (Csikszentmihalyi, 1990) are not engaging because they are not fun to play (Sweetser & Wyeth, 2005). Moreover, the literature suggests that engaging games are more apt to facilitate learning (Moneta & Csikszentmihalyi, 1996; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003).

Currently, several measures of player engagement have been developed for various game types including single-player, entertainment games (Brockmeyer et al., 2009; IJsselsteijn, Poels, & de Kort, 2008; Mayes & Cotton, 2001), educational games (Fu, Su, & Yu, 2009), and virtual simulations (Witmer & Singer, 1998). Variations in existing measures reflect both the wide range of video game genres and goals, and the overall lack of definitional consensus for key theoretical concepts, such as engagement, flow, and immersion (Brockmeyer et al., 2009; Procci & Bowers, 2011). Despite this, one notable similarity is the use of a questionnaire format for gathering player self-report data. Self-report data are undoubtedly essential for gauging players' subjective experiences of game play but may not fully quantify all aspects of player engagement. Objective measures of observable verbal and nonverbal behavior offer additional and complementary information regarding engagement, and they have the potential to provide a more thorough or richer assessment than subjective measures alone.

2.1. Conceptual framework

We propose a conceptual model for measuring player engagement in real-time simulation games that includes predictability, flow, involvement, and perceived realism (see Fig. 1). Predictability, perceived realism, and flow are properties of a game that are reflected in subjective experiences of game play. They are not directly observable. In contrast, involvement is directly observable because as defined in the Oxford English Dictionary, it is the "fact or condition of participating in something" (Involvement). Involvement does not lend itself to self-report because it is not a subjective experience. Hence, it is best assessed with coded or rated observations of game play behavior.

2.1.1. Measurement of involvement

Observational rating systems of nonverbal involvement emerged from researchers interested in interpersonal interaction (e.g., Coker & Burgoon, 1987; Guerrero, 1994; 2005). This system for rating behavioral cues of involvement in human dyadic interactions (i.e., face-to-face conversation) is well established. Although Guerrero's (2005) rating system was developed for human dyadic interactions, we believe that the human–avatar interactions facilitated by DRAMA–RAMA™ can be similarly rated for player involvement. The participants in our study are engaging in dyadic interactions with avatars, albeit via a mediated channel, and the interactions in the game are designed to mimic face-to-face interaction. Our goal is to determine how well this system of observational behavior rating can be used to evaluate involvement behaviors in such interactions.

The system is comprised of six scales: Immediacy, Expressiveness, Altercentrism, Interaction Management, Composure, and Positive Affect. Each scale is designed to capture a dimension (or set) of behaviors relevant to involvement and are defined as follows: (1) *Immediacy* dimension behaviors measure the physical proximity between two individuals; (2) *Expressiveness* dimension behaviors communicate the level of energy, activity, and enthusiasm toward the conversation partner; (3) *Altercentrism* dimension behaviors reflect the degree of focus on the conversation partner during the interaction; (4) *Interaction Management* dimension behaviors support a smooth flow of conversation; (5) *Composure* dimension behaviors reflect an absence of nervous body movements or the presence of confidence; and (6) the *Positive Affect* dimension includes smiling, laughing, and other behaviors that reflect good feelings about the interaction and partner.

The Guerrero (2005) system is uniquely suited for measuring player involvement in a live simulation game involving digital puppetry for three reasons. First, Guerrero's system was designed to

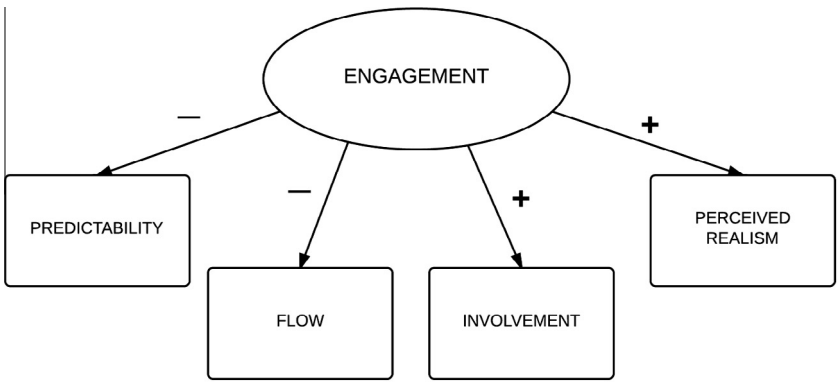

Fig. 1. Theoretical model of engagement.