Must Feedback Disrupt Presence in Serious Games?

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ABSTRACT

Serious games are generally designed with two goals in mind: promoting learning and creating compelling and engaging experiences (sometimes termed *a sense of presence*). Presence itself is believed to promote learning, but serious games often attempt to further increase pedagogical value. One way to do so is to use an intelligent tutoring system (ITS) to provide feedback during gameplay. Some researchers have expressed concern that, because feedback from an ITS is often *extrinsic* (i.e., it operates outside of the primary game mechanic), attending to it disrupts players' sense of presence. As a result, learning may be unintentionally *hindered* by an ITS. However, the most beneficial conditions of instruction are often counterintuitive; in this paper, we challenge the assumption that feedback during learning hinders sense of presence. Across three experiments, we examined how an ITS that provided extrinsic feedback during a serious game affected presence. Across different modalities and conditions, we found that feedback and other ITS features do not always affect presence. Our results suggest that it is possible to provide extrinsic feedback in a serious game without detracting from the immersive power of the game itself.

Keywords

presence, immersion, learning, feedback, serious games, tutoring

1. WHAT'S IN A GAME?

We have all had the experience of being engrossed in an artificial experience, whether it's a good book, an epic movie, a round of golf, or a couple levels of *Angry Birds* on a long elevator ride. Several features of games, especially, can make hours fly by, unnoticed. The interactivity of games draws players' attention from non-game thoughts and stimuli. The rules of the game, too, are designed to add uncertainty and difficulty—and eventual reward—to the pursuit of an objective. Putting a ball into a cup is made fun, for example, by requiring that one use golf clubs to do so—rather than simply picking up the ball, walking over to the cup, and dropping it in. The eventual reward (sinking a putt) compels players to persist and eventually improve.

Real-world games are fun, in part, because they take place in an environment that supports continued play (e.g., a golf course). Digital games, instead, must transport a player to the world of the game. This experience of being in the world of the game is sometimes referred to as a sense of *presence* [1]. Presence can be measured in several ways. The Temple Presence Inventory (TPI), for example, is a robust instrument for estimating the feeling of non-mediation in a multimedia experience [2]. The TPI consists of a series of statements to which participants respond to items such as "How often did you want to or did you make eye contact with a person you saw/heard?" with ratings between 1 (never) and 7 (always). These statements are organized into several subscales, which correspond to various aspects of the experience that contribute to the sense of non-mediation. The two subscales we used were *social* (the experience of direct interaction with an artificial counterpart) and *spatial* (the experience of direct contact with an artificial environment).

2. WHAT'S IN A SERIOUS GAME?

In addition to the standard traits of a digital game (e.g., the difficult pursuit of an in-game objective, creating a sense of presence), *serious games* feature an objective outside the game itself. By "playing" a serious game, one becomes better at a real-world task—or is at least better prepared to learn that task from subsequent instruction or practice [3]. Examples of serious games include CyberCIEGE, which is designed to teach people about the functions of computer network security measures. Another example is Spent, a simple simulation of a U.S. Citizen's experience at the poverty line in a difficult economy with no bootstraps on which to pull. The difficulty, interactivity, and reward structure of serious gameplay can compel students to persist in learning something they would otherwise find dry or boring.

Serious games are also used in part because the sense of presence created by gameplay may improve learning [4, but see 5, 6, 7]. On the other hand, the outside-the-game objective may be in conflict with that intent. Of course, a game-player's sense of presence in a serious (or otherwise overtly educational) game may be disrupted by poorly integrated pedagogical content. For example, some educational games alternate between play and instruction. But even well integrated instructional content may be distracting; the user may occasionally stop to consider how to apply what they are learning to similar real-world tasks. If presence affects learning, this withdrawal may be detrimental.

This potential conflict may be exacerbated when features that are intended to facilitate training are added to a serious game. These

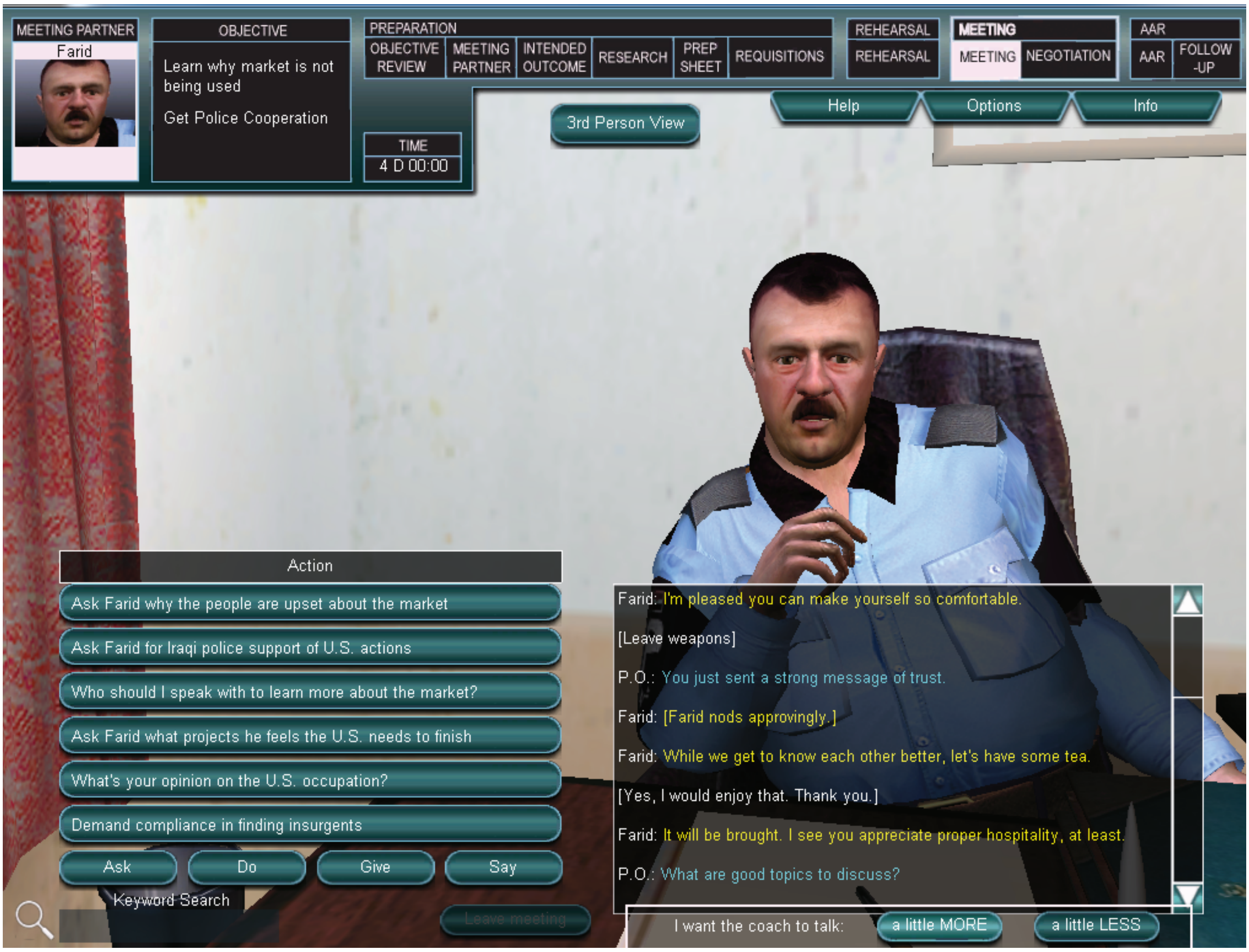

Figure 1. A meeting in BiLAT. In the transcript pane (bottom right), the feedback from the ITS-driven coach appears as blue text. Below that are buttons used to adjust how frequently the coach (P. O., above) decides to intervene (Experiments 2 and 3).

features may directly interfere, or may simply underscore that the player is *using* the game to achieve the external goal, as opposed to *playing* the game because it is fun.

One such feature is an intelligent tutoring system (ITS). An ITS is a computer program or computing device that factors student performance into when and how it generates and provides guidance [8]. The development of ITSs (and other learning-centric game features) is usually guided by principles of cognitive psychology and instructional design [8-10]. However, those principles are often developed in experimental laboratories, in which motivation and fun may not be priorities. Thus, ITSs may provide pedagogically valid feedback, but they may do so in a way that further deepens the rift between gameplay and learning. The goal of the studies reported in this paper was to determine whether extrinsic feedback from an ITS necessarily negatively affects learners' sense of presence when playing a serious game.

3. BILAT: A SERIOUS GAME ABOUT CROSS-CULTURAL NEGOTIATION

The serious game we chose to use for our investigation is the Enhanced Learning Environments with Creative Technologies for Bilateral negotiations (ELECT BiLAT), a screenshot from which is shown in Figure 1. BiLAT provides an environment in which learners can prepare for, execute, and review cross-cultural meetings with virtual characters. The instructional design and underlying structure are focused on knowledge components that relate to culture and negotiation skills.

Before a meeting, players research their meeting partner, learning about his/her interests and experiences. This research provides information that can help the character establish a personal connection with the character during their meeting. Once the meeting begins (shown in Figure 1), players interact with the characters by selecting an action from a menu system of pre-authored actions (e.g., Ask "Who should I speak with to learn more about the market?"). The character responds to the learner with a synthesized voice and physical gestures. The player and the virtual character thus conduct a turn-based interaction, and the transcript of the meeting appears on screen in the panel at the bottom right of Figure 1.

Although dozens of variables govern the actions of the character and the responses that will be chosen, the variable of primary importance is trust. BiLAT characters display a variety of emotions in their responses, but trust is the persistent record of how well players have used their interpersonal and intercultural

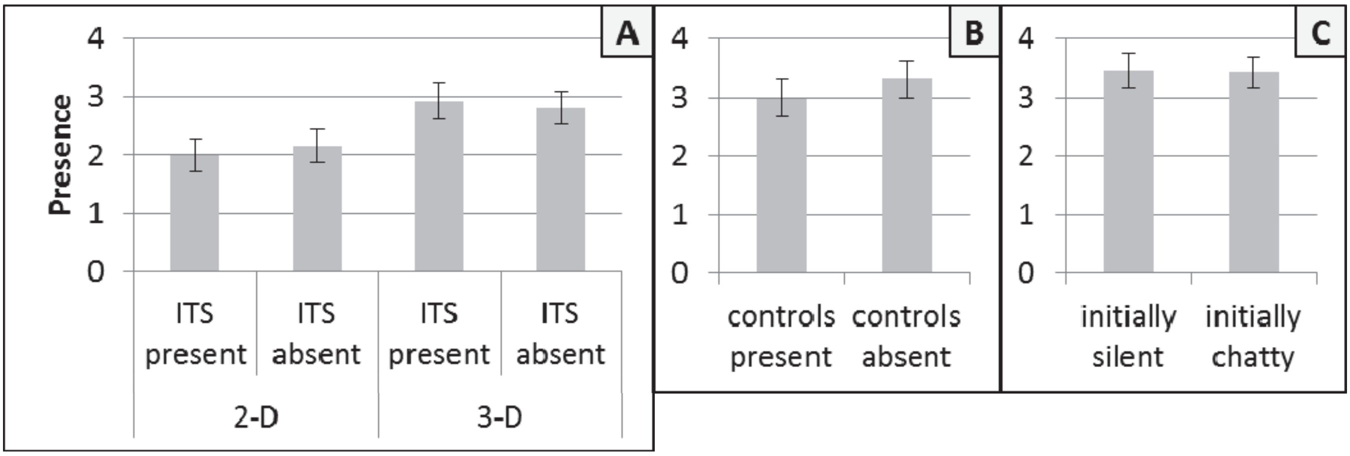

Figure 2. Results from all three experiments. Panel A displays presence as a function of interface richness and ITS activation in Experiment 1. Panel B displays presence as a function of ITS interactivity in Experiment 2. Panel C displays presence as a function of initial ITS feedback frequency in Experiment 3. Error bars represent the standard error of the mean.

skills. In the simulation, trust is a major factor in whether BiLAT characters will agree to negotiate and what deals they will accept. A mistrusting character may demand unfair deals or refuse to negotiate. (For a more detailed description of BiLAT's development and functionality, please see [11, 12].)

The characters' responses and decisions can be considered *internal feedback*. They help the player grasp the knowledge components through the primary interaction that constitutes gameplay. For example, if the player decides to offer the character a bottle of wine as a gift, the character will be offended and say so: "I can't believe you'd even bring that into my home." Depending on what the player has encountered both in and out of BiLAT, the player may conclude that the character does not like wine or that wine is a culturally inappropriate gift.

During BiLAT gameplay, learners can be assisted by an ITS. In meetings with characters, the ITS takes the form of a disembodied, omniscient "coach." The player can read the coach's input in the transcript pane, but the meeting partner is not aware of the coach's presence or input. In other words, the coach is an angel on the player's shoulder. The input the coach provides is outside of the primary interaction that constitutes gameplay; it is *external feedback*.

The coach can provide guidance about past actions ("A bottle of wine probably wasn't the best gift.") or hints about future actions ("What gift can you give Hassan as a gesture of goodwill?"). This advice can be either very general (i.e., focused on the underlying knowledge components) or very specific to something a player has done. For example, the coach could decide to say "Don't give Hassan a bottle of wine" or "Make sure your gifts are culturally appropriate." (For a detailed description of the ITS architecture, please see [13].)

4. EXPERIMENT 1: THE EFFECTS OF EXTERNAL FEEDBACK ON PRESENCE

In Experiment 1, we examined the effects of explicit ITS feedback on learners' sense of presence during BiLAT gameplay. The manipulation was straightforward: whether the ITS was active or inactive during gameplay. We also added another manipulation: whether the sensory experience was rich or poor. Our goal in adding this manipulation was to ensure that we would be able to detect effects on presence with our system, procedure, and participation numbers. Thus, one group of the participants encountered the standard BiLAT experience: a 3-D environment in which a virtual character with realistic body language talks to the player in accented English. The other group of participants encountered a simplified, silent, primarily text-based 2-D environment. We held constant all other aspects of the system for the two groups. Specifically, the BiLAT characters drew from the same sets of utterances and the coach used the same algorithms to decide when to intervene. Only the interface of the two groups' experiences differed. After interacting with the system in one of the four resultant (randomly assigned) conditions, the participants completed the TPI.

Panel A of Figure 2 shows that there was a main effect of interface on presence. A greater sense of presence was created by the 3-D interface (M = 2.88, SE = .21) than by the 2-D interface (M = 2.08, SE = .20): $F(1, 45) = 7.86$, p = .007. There was not a main effect of ITS activation on presence. Indeed, presence ratings were similar in the active-ITS condition (M = 2.46, SE = .20) and the inactive-ITS condition (M = 2.49, SE = .20): $F < 1$, *ns*. There was also no interaction between interface and ITS activation on presence: $F < 1$, *ns*. It appears that receiving extrinsic feedback from an ITS does not necessarily affect presence. Thus, any pedagogical benefit provided by the ITS appears not to burden the immersive experience.

5. EXPERIMENT 2: THE EFFECTS OF FEEDBACK CONTROLS ON PRESENCE

In Experiment 1, the activity of the ITS was entirely out of the participants' control. In Experiment 2, we added interactivity to the ITS. We gave the participants the ability to modify the coach's behavior. We thought that this interactivity might cause the participants to attend to the coach (or the external training goal of the serious game) in a way that would disrupt presence.

There were two groups of participants, both of which encountered the standard, 3-D BiLAT system with the coach operating according to its default algorithms. One of the groups was also provided with "coach controls." These controls took the form of the buttons seen in the bottom right corner of Figure 1. These buttons suggested to the participants that they could nudge (up or down) the frequency with which the coach decided to intervene.

The controls, however, were only cosmetic (although they still visually and aurally behaved like other in-game buttons). We chose to display but disable them in order to manipulate the participants' *belief* that they could control the coach without allowing learning, performance, success, or frustration to vary uncontrollably. After interacting with the system in one of the two (randomly assigned) conditions, the participants completed the TPI.

Panel B of Figure 2 shows that there was no main effect of ITS controls on presence: $F(1, 22) < 1$, *ns*. This result provides more evidence that even direct interaction with an ITS outside the primary game mechanic does not necessarily disrupt presence.

6. EXPERIMENT 3: THE EFFECT OF ITS HELPFULNESS ON PRESENCE

Experiment 3 was designed to extend Experiment 2. Our goal was to determine whether the BiLAT ITS could deliver feedback in a way that would disrupt presence. To that end, we modified the coach's feedback-timing algorithms to draw even more attention to the ITS than in Experiment 2. For one group of participants, the coach began the session in complete silence. For the other group of participants, the coach began the session by speaking up on every single turn. We activated the "nudge" controls, which were merely cosmetic in Experiment 2, to encourage the participants to interact with the ITS as much as possible. Each press of "a little more" or "a little less" changed (by 5%) the probability that the coach would speak up on the next turn. After interacting with the system in one of the two (randomly assigned) conditions, the participants completed the TPI.

As can be seen in Panel C of Figure 2, the participants in both conditions provided similar presence ratings: $F(1, 22) < 1$, *ns*. That is, whether the participants' experience began with constant chatter or complete silence from the ITS, their sense of presence remained relatively unaffected. Moreover, in comparing the three panels in Figure 2, it is clear that the participants' overall ratings were similar across all three experiments—despite drastic differences in feedback algorithms and ITS interactivity. It seems that, unless an ITS is designed with the express purpose of disrupting gameplay, it may not interfere with the immersion created by a serious game.

7. GENERAL DISCUSSION

Interpersonal and intercultural skills, to be frank, may not be the most compelling instructional topics. However, when playing BiLAT, players and participants become very engaged. A participant in one study, when meeting with a particularly stubborn character, took off his headphones and threw them across the room, saying "I *know* he wants to agree to it, and he's just trying to give me a headache!"

Our research demonstrates that this sense of presence is not necessarily disrupted when external feedback from an ITS is added to a serious game. Further, learners can even be instructed to directly interact with the ITS, yet still suffer no decrement to self-reported presence. On the other hand, the use of a single, self-report measure of presence is a limitation of the present study. A more compelling case may be presented by including corroborating physiological data. (We did not examine measures of performance or learning because it would have been impossible to disentangle from each other the effects of feedback on presence, feedback on learning, and presence on learning.)

Although these results may seem surprising, external stimuli interrupt engaging experiences quite frequently, often with no negative results. Many people have put down and then resumed an engrossing book—and been able to reinstate their enjoyment of and engagement with the story. Perhaps a compelling narrative or rewarding gameplay may make some serious and educational games robust to interruptions, as well. In these cases, people may be able to suspend and resume their engagement as they wish. If so, it is interesting to consider the extent to which developers can add pedagogically focused game features without sacrificing learners' immersion. It is reasonable to assume there is some limit to the intrusiveness an ITS can exhibit while still being effective—but the present studies suggest that that limit is above zero.

8. ACKNOWLEDGMENTS

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