

Antecedents of Attributions in an Educational Game for Social Learning: Who's to Blame?

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Abstract. Games are increasingly being used as educational tools, in part because they are presumed to enhance student motivation. We look at student motivation in games from the viewpoint of attribution theory, which predicts more learning by students who make attributions along certain dimensions, and thus may provide a way of examining this claim in more detail. We studied 13 students as they played a game designed to teach negotiation skills in a cultural context. Students' overall attributional style was surveyed, as well as their achievement attributions following each meeting with a game character. Correlational results show that unexpectedly, students' attributional style does not predict in-game attributions. However, characteristics such as gender, negotiation expertise, and frequency of game play are significantly correlated with particular in-game attributions. Because attributions have been shown to be causally related to learning, with further study, such results might be used to positively influence educational game design.

Keywords: Virtual environments, motivation.

1 Introduction

Simulation-based instructional systems are increasingly being used to facilitate learning social or interpersonal skills such as conflict resolution by simulating human behavior with virtual characters [18]. These skills are currently taught through role-playing exercises and tutoring, both of which are very resource-intensive teaching methods [11]. Computer-based simulations, which are becoming increasingly realistic, offer a major advantage for social learning by providing a cheaper solution to a much larger number of students. Such simulations are often turned into a game-like experience by adding elements like goals, scores, or rules, in an attempt to take advantage of the motivating potential of games [13]. Examples of existing game-based instructional systems with social learning components include Tactical Iraqi

[10], BiLAT [8], and PeaceMaker [1]. Motivation is important in learning contexts because it can lead students to make greater effort, seek greater challenges, set higher goals, and have higher achievement (see [19]). However, we do not yet have a complete empirical understanding of motivational effects in educational games.

A theoretical framework that is useful for understanding motivation in a learning context is achievement attribution theory [20]. Based on the assumption that humans are rational decision makers who seek to understand the causes of their own behavior, attribution theory describes the explanations that people make for events in their life. In particular, achievement attribution looks at how people explain their performance at tasks. Achievement attributions are described along three causal dimensions that have been shown to be critical factors in the attributional process [21]. Locus of control refers to whether the cause to which events are attributed is internal (e.g., high ability) or external (e.g., a difficult test) to the student. Stability refers to how constant the perceived cause is over time; for example, some students might consider ability to be stable over time, while others believe it can change. The third dimension, controllability, refers to the belief that the perceived cause can be controlled (e.g., a teacher can control the difficulty of the test), or not (e.g., luck). These attributions are important because they tend to lead to behavioral changes that affect learning. Students who attribute their success to internal and controllable causes like amount of effort put forth, and attribute failure to unstable causes like an exceptionally difficult test or lack of effort, tend to have better learning outcomes. Those who attribute success to external causes like luck and attribute failure to stable internal causes like lack of ability, tend to have lower learning outcomes; these attributions may be termed ‘maladaptive’, particularly when they are inaccurate. These attributions also seem to be causal; a number of studies have shown that we can retrain students to make successful attributions, or those that lead to more learning (e.g., [15]). Therefore, if improving attributions helps learning, understanding people’s attributions in games may ultimately lead to better educational game design.

Many possible factors are proposed to be antecedents to students’ attributions, and they tend to be divided into two groups: environmental factors and personal factors. One personal characteristic proposed to influence attributions in an achievement task is attributional style [16]. Attributional style is the tendency to make attributions along the above dimensions in similar ways across many contexts. Additionally, gender can be a factor. Gender differences have had conflicting results in the literature, with some researchers finding that women tend towards more maladaptive patterns of attributing success and failure, and others finding no difference (see [4], or [5], for a discussion). Finally, a factor more recently thought to influence attributions is prior knowledge of a domain [7]. Previous models posited that attributional factors were content-free and thus operate in any domain.

Two environmental factors are relevant to learning with games. Although video games are becoming more ubiquitous as an entertainment activity, not everyone plays games. Comfort with game environments might play a part in students’ attributions. Games might produce novel patterns of attributions because students may have more experience playing outside of a learning context, and thus may have different schemas for how to approach gameplay. Secondly, in games that teach social skills (here,

cultural negotiation), it may be the case that not all external attributions exert equal influence on student learning. The locus of control dimension typically focuses only on whether the cause of an event is internal or external, but we introduce various external actors as possible antecedents of attributions. We distinguish between attributions to the virtual characters, the culture of the characters, and the game itself, as seems appropriate in a cultural negotiation game.

In this paper we describe an exploratory study that investigates the attributions of students in an educational game for learning cross-cultural negotiation. We explore the following question: how do students' achievement attributions relate to success in this game, and to the above identified environmental and personal factors? We hypothesize that key differences from standard attribution findings will be that gamers will tend to place more blame on the game when they fail, and successful students will give more credit to the virtual characters or the culture. We present exploratory results from reports of students' achievement attributions and correlations with success in the game. With further study, such results might be used to positively influence educational game design.

2 Game Context

The context we use for our investigation is BiLAT [8], a game-based simulation for practicing bilateral negotiations in a cross-cultural context. The BiLAT architecture is built on Unreal Engine 2.5 and integrates research technologies such as virtual human characters and intelligent tutoring support. BiLAT was designed to address learning objectives related to negotiation generally, as well as the specific cultural knowledge and skills that support more effective negotiations in a particular culture (see [3], for more about cultural learning objectives). One primary learning objective is considering the counterpart's interests in order to achieve "win-win" results. A series of scenarios presented to the student drive the game experience. The initial scenarios are set in an Iraqi town, and the student is put into the role of a U.S. Army officer tasked with meeting with members of the town in order to accomplish specific goals (see Fig. 1).



Fig. 1. At left, a meeting in BiLAT with police captain Farid with the goal of solving a problem with a market in an Iraqi town. At right, meeting partner Na'eema, a doctor.

To play, the student begins by preparing for a meeting in the “prep room.” Here, the student learns about the character and the scenario from a number of different sources of varying degrees of trustworthiness. The student then moves into a meeting with a virtual Iraqi. The student communicates with BiLAT characters by selecting from a menu of hand-authored communicative actions. Underlying each virtual character is a social simulation with a model of culture and personality. Characters’ responses also depend on a number of factors, including the current meeting phase, his or her current level of trust in the student, and a virtual dice roll. The dice roll is intended to simulate uncertainty in human behavior – cognitive and emotional modeling techniques can be used to simulate these reactions in more principled ways [8]. The character responds to the actions in both text and synthesized speech, as well as non-verbal behaviors such as gestures.

3 Exploratory Study

We conducted an exploratory study with participants from diverse backgrounds. The goal was to investigate their achievement attributions, and in general to gain a broad sense of how learners approach playing such a game. Participants in our study met with two different virtual characters while engaging in a think-aloud protocol and completing various attributional surveys. We investigated personal and environmental characteristics as possible antecedents for their attributions. We hypothesized that key differences from standard attribution findings will be that gamers will tend to place more blame on the game when they fail, and successful students will give more credit to the virtual characters or the culture.

3.1 Participants

The 13 participants ranged in age from 19 to 54 ($M = 34$). We made an effort to recruit participants who varied in their frequency of game play on a 4-point scale (never, rarely, monthly, weekly; $M = 2.8$, $SD = 1.15$), as well as in their self-rating of negotiation skill on a 7-point scale ($M = 3.15$, $SD = 1.4$). They were compensated \$40 for a two and a half hour session.

3.2 Method

Students began by taking a demographics questionnaire, and surveys of baseline attributional style and goal orientation (described below). Each student then watched an introductory video about concepts and skills related to the learning objectives of the game, and took a pretest on these concepts (also described below). Next, they entered the game and met with two different characters. Each negotiation with a character began in the “prep room” of the game where the student acquired information about the character and the current scenario. The student then met with the character until an agreement was reached in the negotiation or the allotted time ran out. At this point students were given the achievement attribution survey described below, and then moved along to the subsequent negotiation after which they completed a second attributional survey. Throughout this process the students were

prompted to think out loud using the protocol developed by Ericsson & Simon [6]. After the student met with both characters, he or she left the game and took a posttest identical to the pretest. Finally, the experimenter conducted an open-ended interview.

3.3 Measures

In the pretest and posttest, learning of the intercultural negotiation skills was assessed by a Situational Judgment Test, a type of assessment used in ill-defined domains that asks students to rate the appropriateness of various actions based on situations related to the learning objectives [12]. While this test has been used previously to collect data with students playing BiLAT, we do not report on the results here due to ceiling effects reached with the training video.

To measure predispositions towards motivational patterns, we gave students two surveys. The Goal Orientation survey [2] measures performance versus learning or mastery orientation. In this survey, students rate how strongly they feel various statements about performance or learning goals apply to them, on a 7-point Likert scale. The Attributional Style Questionnaire [17] measures a person's attributional style, or their general tendency to explain positive or negative events along the causal dimensions discussed above.

Following each session with a character, we gave students an attribution survey for that particular task based on the Revised Causal Dimension Scale [14], which asks them to rate their own performance at the task and think of the major cause for their performance. They then rate this cause on a 9-point Likert scale along each dimension (locus of control, controllability, and stability). Typically, locus of control items ask responders to make a choice as to whether the cause of an event is internal or external. Because cultural games have many different actors who we believed may produce differential effects on student behavior, we decided to split the locus of control dimension to address particular external actors. Therefore we added questions that asked students to rate whether the cause of the event was due to the game itself, the programmers of the game, the character they had interacted with, or the culture the character belonged to. Because in our data we found that making attributions to the game was very highly correlated to making attributions to the programmers, we discuss these two as one external actor.

4 Results

We measured success in the game by determining the number of negotiation objectives each student met in each negotiation. In the first of the two negotiations, we found that students' attributions were significantly correlated to their success. Specifically, success was highly correlated to an internal locus of control ($r=.659$, $p=.014$) and to feelings of controllability ($r=.681$, $p=.01$). It was negatively correlated to blaming the programmers ($r=-.581$, $p=.037$). An independent-samples t-test showed that there were significant differences in attributions between genders in this negotiation. Women ($M=4.58$, $SD=.74$) felt that their performance was less

controllable than men ($M=6.81$, $SD=1.14$); $t(11)=3.54$, $p=.005$. Women were also more likely to attribute their performance to the game ($M=7.00$, $SD=.86$) than men ($M=4.56$, $SD=2.00$); $t(11)=-2.31$, $p=.042$. They were marginally less successful than men at achieving the objectives in the game ($M=.13$, $SD=.25$; $M=.67$, $SD=.5$; $t(11)=2.02$, $p=.068$).

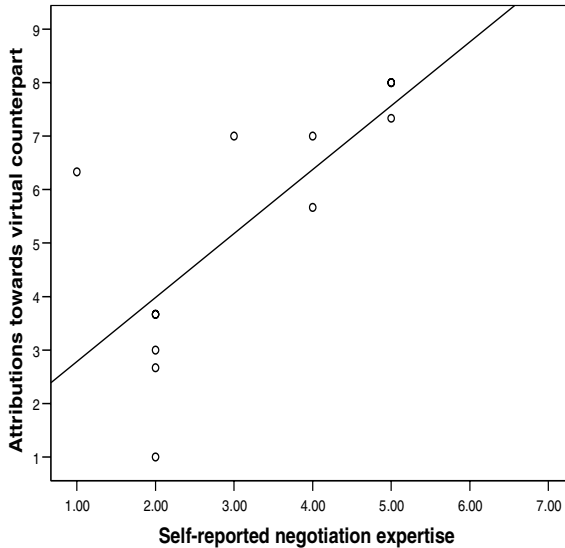


Fig. 2. Attributions towards virtual counterpart by negotiation expertise, negotiation 2

In the second negotiation, performance dropped significantly ($M=.54$, $SD=.49$; $M=.25$, $SD=.45$; $F(1,11)=5.04$, $p=.046$), as did students' rating of their own performance on a 7-point Likert scale ($M=5.15$, $SD=1.77$; $M=3.58$, $SD=1.93$; $F(1,11)=4.91$, $p=.049$). In this negotiation, success was not correlated to any pattern of attributions (all r values $< .2$). Additionally, gender no longer had any effect on attributions along any dimension (all r values $< .2$). However, significant correlations between attributions and other demographic characteristics of students did appear. In the second negotiation, students with more negotiation expertise were more likely to attribute their performance to the character in the game ($r=.728$, $p=.007$, see Fig. 2) and the culture ($r=.596$, $p=.041$), and less likely to attribute their performance to internal factors ($r=-.775$, $p=.003$) or to feel that it was controllable ($r=-.751$, $p=.005$, see Fig. 3). However, self-rating of 'knowledge of Arab cultures' was not significantly related to attributions. Students' frequency of game play was negatively correlated with attributing performance to the BiLAT game ($r=-.596$, $p=.041$, see Fig. 4). As we had attempted to recruit participants with a wide range of experience, none of these learner characteristics were correlated with each other.

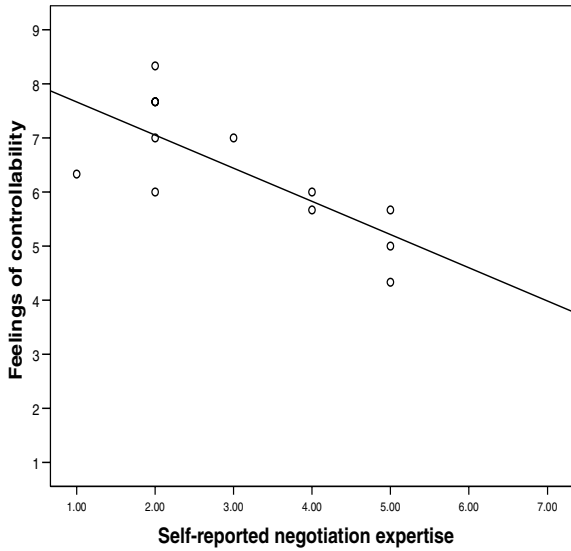


Fig. 3. Controllability of performance by negotiation expertise, negotiation 2

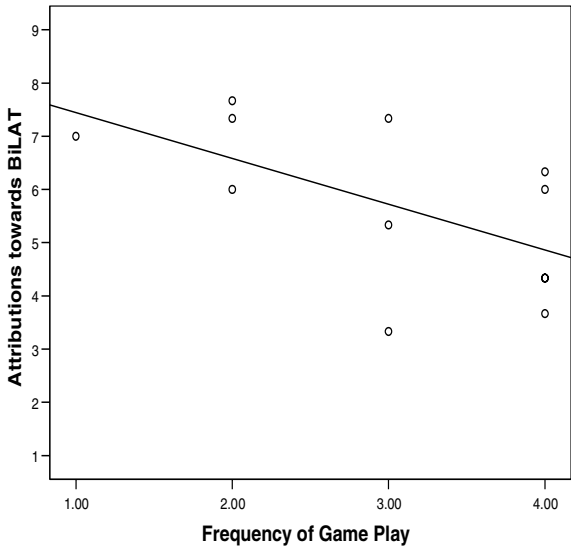


Fig. 4. Attributions towards BiLAT by frequency of game play

In general, attributions made for performance in either negotiation were not significantly correlated with responses to the Attributional Style Questionnaire (all r values $< .2$).

5 Discussion and Conclusions

In the first negotiation, we saw typical relations emerge between performance and attributions. Success was linked with feelings of control and feeling like one is personally responsible, and is negatively correlated to feeling like the environment is responsible for one's performance. This pattern is called a *self-serving bias*, and may be a method of managing impressions or saving face [22]. While the self-serving bias may correlate to some positive behaviors, it is also indicative of some maladaptive motivational patterns. We also found that females may have had difficulty in adjusting to the environment – they were slightly less successful, felt like their performance was out of their control, and blamed the game instead of themselves. This pattern may be detrimental to females' self-efficacy and to their persistence in continuing with the game [19]. As noted in the introduction, it is congruent to findings by some researchers that females tend to have maladaptive patterns of attributions. Also, research that shows that women tend to be less comfortable operating in computer or video game environments may be relevant [9, 23].

By the second negotiation, however, the task became more difficult for everyone. The character in the game was more difficult to negotiate with, and performance dropped. When this happened, there was no consistent relation between attributional dimensions and learning across all students. Instead, it appeared that some environmental and personal factors were predictor of attributional patterns. On one hand, experience with similar environments made a difference. Contrary to our hypothesis, students who played more games were less likely to blame the game for their poor performance. As frequent gamers, it may be that these students have implicitly agreed to abide by the rules that are constructed in games, and therefore do not identify the game as a source of error when they fail. We also found that some prior knowledge was predictive of attributional patterns. Students with more negotiation experience were more likely to share responsibility with the character they were engaging with, as well as the culture, and were less likely to feel that the events were controllable. This may be due to their experience negotiating in the real world; when there is a counterpart involved in a negotiation, the outcome is most likely dependent on both parties. Realizing that you do not have full control, and that outcomes are *sometimes* due to factors not fully under your control, may actually be an adaptive rather than a maladaptive attributional pattern, as we hypothesized. However, self-rating of knowledge of Arab cultures did not correlate to attributions in the same way. Among possible explanations are that students are not very good judges of their own knowledge in this domain, or that knowledge of a culture does not always translate to skill in interacting with that culture. Interestingly, in the second negotiation, women had similar attributions to men. It may be that they became more comfortable with the environment over time, or that these differences were washed out when the game became more difficult.

This work describes the motivational antecedents of students who are learning in an educational game environment for cultural negotiation. Several general patterns emerged from our results. When game difficulty was high, attributions were not predicted by attributional style, but rather by experience in the particular type of learning environment and in the domain. This finding supports the idea that prior knowledge may influence attributions, in particular when relevant external actors are

considered. Also, we found evidence that gender is indeed a factor to consider when developing motivational interventions for games. Next steps in this work will be to correlate attributions with learning outcomes beyond success in the game, to determine when or if some of these novel patterns may be beneficial to learning. These results can then be used to design better game-like learning environments which guide students towards those motivational processes that will help them be more persistent, more effortful, and achieve more. This work contributes to understanding how students engage with an educational game that teaches social skills, and to opening up new avenues for research in motivation in these environments.

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