



Designing motivational agents: The role of praise, social comparison, and embodiment in computer feedback

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ABSTRACT

The present study draws on theories of attribution, social comparison, and social facilitation to investigate how computers might use principles of motivation and persuasion to provide user feedback. In an online experiment, 192 participants performed a speed-reading task. The independent variables included whether or not the verbal feedback from the computer involved praise, whether the objective feedback showed that the participants were performing better or worse from their peers, and whether or not the feedback was presented by an on-screen agent. The main dependent variables included a subjective measure of participants' intrinsic motivation and an objective measure of their task persistence. Results showed that providing participants with praise or comparative information on others' performance improved intrinsic motivation. When praised, participants whose performances were comparatively low persisted in the task longer than those whose performances were comparatively high did. Additionally, the mere presence of an embodied agent on the screen increased participants' motivation. Together, these results indicate that praise and social comparison can serve as effective forms of motivational feedback and that humanlike embodiment further improves user motivation.

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1. Introduction

In their day-to-day lives, people interact with a number of social actors who seek to persuade and motivate them to pursue their goals. Doctors seek to persuade their patients to change unhealthy habits. Teachers wish to motivate students to be more attentive and study more frequently. Individuals look for exercise partners who could inspire them to follow an exercise regimen. Computers hold great promise as motivational social actors, seeking to change people's attitudes, beliefs, and behaviors and improve motivation and compliance in such areas as work, education, health, and wellbeing (Annesi, 1998; Bickmore, 2003; Fogg, 2003; Gockley & Mataric, 2006; Nagata, 1993; Schulman & Bickmore, 2009). Meta analyses of studies on the benefits of computer-based systems have shown improvements in health and wellbeing practices (Portnoy, Scott-Sheldon, Johnson, & Carey, 2008), physical exercise and activity (Spittaels, De Bourdeaudhuij, & Vandelanotte, 2007), attitudes towards exercise (Schulman & Bickmore, 2009), and the management of mental and behavioral conditions (Reger & Gahm, 2009).

Research in human–computer interaction (HCI) has explored whether or not motivational strategies from human–human communication are effective when employed by computers. Results from these studies suggest that verbal feedback from a computer

in the form of praise (Fogg & Nass, 1997) or criticism (Bracken, Jef-fres, & Neuendorf, 2004) improves the user's motivation. Research on motivation, however, suggests that verbal feedback might negatively affect motivation when not used appropriately (Brophy, 1981; O'Leary & O'Leary, 1977). How, then, should computers use verbal feedback to effectively improve motivation? Under what circumstances would verbal feedback be appropriate? What other strategies might a computer employ to provide feedback to users? Furthermore, the studies in this area explored voice (Fogg & Nass, 1997; Nass, Steuer, Henriksen, & Dryer, 1994) and text (Bracken et al., 2004) as the media in which the computer delivered verbal feedback. How do other media and representations affect the motivational effects of computer feedback? Research on educational environments show that the mere presence of an embodied humanlike agent—simulated characters that embody humanlike qualities—has a positive effect on the user's motivation to use the environment (Elliott, Rickel, & Lester, 1999; Lester, Towns, Call-away, Voerman, & FitzGerald, 2000; Schulman & Bickmore, 2009), suggesting that humanlike embodiment might have an effect on how verbal feedback affects user motivation.

The current study draws on theories of attribution (Dweck, Davidson, Nelson, & Enna, 1978), social comparison (Festinger, 1954), and social facilitation (Zajonc, 1965) to investigate how computers might use praise, comparative evaluation, and humanlike embodiment to improve user motivation and task persistence with the computer. The following paragraphs provide an overview of these theories and describe the hypotheses that they inform.

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1.1. The role of feedback in motivation

In all task domains ranging from learning to work, people feel the need to evaluate their performance (Festinger, 1954). Research has shown that knowledge of one's performance improves task outcomes and motivation (Ammons, 1956). These evaluations allow individuals to assess their competence at the task at hand and their control over their performance and behavior in that task and determine their intrinsic motivation, the drive to pursue an activity for its inherent satisfaction as opposed to satisfying for a separable outcome (Deci, 1975; Deci & Ryan, 1985; Ryan & Deci, 2000). Research on motivation suggests that feedback—information provided by an agent (e.g., teacher, peer, book, parent, self, experience) on one's performance or understanding—can serve as a form of evaluation and that the type of feedback can have a significant effect on one's levels of intrinsic motivation (Hattie & Timperley, 2007). Specifically, positive, information-based feedback given in response to performance in a task increases perceptions of competence and, therefore, intrinsic motivation (Deci, 1975; Deci & Ryan, 1985).

Feedback on performance can be presented through interpersonal means (e.g., an evaluator might say "You did really well") or through objective comparison (e.g., displaying the number of correct answers on a test) (Jussim, Soffin, Brown, Ley, & Kohlhepp, 1992). Research in education has shown that positive interpersonal feedback—often referred to as praise—increases task-related behaviors, motivation, feelings of competence, and task success (Brophy, 1981; Swann & Pittman, 1977; Ferguson & Houghton, 1992; Sutherland & Wehby, 2001; Thomas, 1991) and has recommended praise as an essential tool for educators to provide encouragement, build self-esteem, and promote stronger teacher-student relationships (Brophy, 1981). Studies in human-computer interaction have shown that praise from a computer increases users' willingness to continue working (Fogg & Nass, 1997).

1.2. Attribution theory

Research also suggests that praise might be detrimental to intrinsic motivation, particularly when not used appropriately. For praise to work as an effective reinforcer, it must be contingent, specific, sincere, and credible (O'Leary & O'Leary, 1977). *Attribution Theory* suggests that individuals need to associate the praise with their performance or behavior (Dweck et al., 1978). Praise that is not contingent on their performance or behavior might cause embarrassment, discouragement, and other undesirable outcomes (Brophy, 1981). Furthermore, praise might cause individuals to rely on praise as a motivator, replacing intrinsic motivators such as self-reinforcement (Glynn, Thomas, & Shee, 1973; McLaughlin, 1976; Montessori, 1964; Moore & Anderson, 1969) and to perceive the evaluator as an authority figure, replacing an equal individual-evaluator relationship (Brophy, 1981). Praise can reduce motivation when individuals have been engaged in the praised task for its intrinsic value (Deci, 1975; Lepper & Greene, 1978). Level of performance or ability might also affect how individuals perceive praise (Brophy, 1981); studies in classrooms suggest a positive correlation between praise and learning outcomes in low-performing students and no correlation or weak negative correlation in high-performing students (Anderson, Evertson, & Brophy, 1979; Brophy & Evertson, 1976; Cantrell, Stenner, & Katzenmeyer, 1977; Good, Ebmeier, & Beckerman, 1978; Martin, Veldman, & Anderson, 1980). These studies suggest that praise can be an asset for an evaluator to improve intrinsic motivation and task performance, but only when employed under certain circumstances. It must be contingent, specific, sincere, and credible and it might not improve motivation or task performance in high-performing individuals or in those who are engaged in a task truly for its intrinsic value.

1.3. Social comparison theory

A second significant source of feedback that people use is objective comparison—comparing their performance and abilities to like others (Brickman & Berman, 1971; Suls & Tesch, 1978). *Social Comparison Theory* suggests that comparing one's performance or abilities against like others might improve intrinsic motivation, even when the comparison shows poor performance (Festinger, 1954). Social comparison, particularly comparison with higher-performing others, introduces competition and motivates individuals to increase their efforts (Suls & Tesch, 1978). Comparison of performance in novel tasks provides individuals with the means to determine whether they should sustain their efforts in the task (Levine, 1983). In learning settings, social comparison might be beneficial for some and detrimental for others. Comparing one's performance against a high-performing student might cause an individual to feel inferior and discouraged and negatively affect self-esteem. Alternately, such comparisons might also cause low-performing students to seek to emulate high-performing peers and learn from them.

1.4. Social Facilitation Theory

While most studies on the role of feedback in motivation focus on verbal or written feedback from a teacher or peer, computer feedback might take a number of forms from text to verbal feedback by an embodied agent. *Social Facilitation Theory* suggests that the presence of an embodied humanlike agent may increase motivation because the presence of other people increases an individual's drive and enhances performance in tasks in which the individual is competent (Zajonc, 1965). Research in human-computer interaction has shown that even the presence of a static image of an agent can improve user motivation, arguing that the presence of an agent makes the computer more social and lifelike and, thus, increases engagement and motivational impact (Elliott et al., 1999; Lester et al., 2000; Moundridou & Virvou, 2002; Schulman & Bickmore, 2009; Sproull, Subramani, Kiesler, Walker, & Waters, 1996; Walker, Sproull, & Subramani, 1994).

1.5. Hypotheses

Studies in HCI suggest that praise from a computer increases motivation and persistence on a task (Fogg & Nass, 1997). By offering praise via words, images, symbols, or sounds, computers can lead users to be more open to persuasion.

Hypothesis 1. People who receive praise will be more motivated to perform a task than people who do not receive praise.

Social Comparison Theory suggests that comparing one's performance or abilities against like others might improve intrinsic motivation (Festinger, 1954).

Hypothesis 2. People whose performances are compared against those of their peers will be more motivated to perform a task than people whose performances are not compared to those of others.

Praise in response to performance on a task increases perceptions of competence, and therefore, intrinsic motivation (Deci, 1975; Deci & Ryan, 1985), suggesting that when users know through objective means that they performed well, praise will not significantly affect their motivation and perceptions of their competence. In contrast, when users know that they performed poorly, praise will improve their motivation and perceptions of competence.

Hypothesis 3. Praise will improve motivation in people who believe they perform poorly but not in people who believe they perform well.

Finally, Social Facilitation Theory (Zajonc, 1965) argues that the presence of others increases an individual's drive and enhances

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