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.

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, ScottSheldon, 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, Jeffres, & 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

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(Elliott, Rickel, & Lester, 1999; Lester, Towns, Callaway, 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.

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 performance in tasks, suggesting that the mere presence of an embodied agent would improve user motivation.

Hypothesis 4. When the computer presents the image of an onscreen agent along with verbal feedback, people will be more motivated than when it presents no on-screen agent with feedback.

2. Method

2.1. Participants

One-hundred-and-ninety-two participants (82 males and 110 females) took part in the experiment, placing 16 individuals in each of the unique 12 conditions. They were recruited through Amazon.com's Mechanical Turk online marketplace. The recruitment process followed crowd-sourcing best practices to minimize the risk of abuse and to achieve a wide range of demographic representation (Ipeirotis, 2010; Kittur, Chi, & Suh, 2008). Only users who are residents of the US with an approval rating of 95% or greater were allowed to participate. IP-number-based filtering techniques ensured that the participants could not perform the experiment more than once. Participants received $0.30 for their participation.

2.2. Measurements

A sub-scale of the Situational Motivation Scale (SIMS) developed by Guay, Vallerand, and Blanchard (2000) measured intrinsic motivation, particularly how intrinsically motivating users found the task and their likelihood and willingness of performing it again in the future (see Appendix A for the scale items used). Task persistence was measured as the number of rounds that a participant played including the required minimum of five rounds. After five rounds, participants had the option to quit or continue at the end of each round. All subjective measurements used seven-point rating scales anchored by ''Strongly Disagree'' and ''Strongly Agree'' on the two ends.

2.2.1. Manipulation check

The effectiveness of the praise manipulation was assessed by asking participants whether they perceived the verbal feedback from the computer to be praiseful. To test the effectiveness of the social comparison manipulation in shaping participants' perceptions of their performance, a scale using three items was developed and used: ''I feel I performed well,'' ''I am satisfied with my performance,'' and ''I feel I performed better than most people'' (Cronbach's $\alpha = .90$).

2.3. Design

A 2 (no agent vs. agent) x 2 (no praise vs. praise) x 3 (no comparison vs. positive comparison vs. negative comparison) between-subjects experiment tested the hypotheses described earlier. In the experiment,

participants played an interactive online game, which asked them to count the number of occurrences of a particular letter in a given sentence (see Appendix B for example sentences) as quickly as possible, enter their answer in a text box, and press a button to submit it. If the answer was incorrect, the computer asked participants to try again. If the answer was correct, the computer displayed a feedback screen. Fig. 1 illustrates the game and feedback screens that the computer displayed to the participants. Appendix C includes the script that the computer followed to provide participants with game instructions. The experimental manipulations varied how the computer presented feedback on the participants' performance, particularly the use of praise, social comparison information, and agent embodiment. This screen also had a button labeled "Next Sentence" which would, when pressed, start the next round of the game. Participants were told that they had to perform at least five rounds. After five rounds, the interface displayed another button labeled "I Am Done" next to the button labeled "Next Sentence," which allowed participants to stop at any time.

2.3.1. Praise manipulation

On the feedback screen, participants either received neutral feedback (e.g., "You have entered the correct answer.") or praise (e.g., "Keep going, you're doing great." or "Nice job. Keep it up.") from the computer. In order to add more credibility to the verbal feedback, the computer modified the feedback message in one of every five rounds of the game to a moderately negative one (e.g., "I think you can do better than that. Try again."), following a strategy employed in previous research on praise (Fogg & Nass, 1997). For example, a participant in the praise condition who performed the task ten times received eight positive responses and two moderately negative responses.

2.3.2. Social comparison manipulation

The feedback screen also displayed the amount of time it took participants to provide the correct answer. Along with information on their performance, participants were shown either no comparison information, negative comparison information, or positive comparison information. In the negative and positive comparison conditions, the interface displayed a time value labeled "Average time among participants" below participants' actual time, providing them with a measure to compare their performance against the performance of others. This information did not reflect the actual average gathered from all participants, displaying instead a number that the computer generated to be below or above the participant's performance. In the negative comparison condition, the computer calculated this number by multiplying the participant's actual performance value by a random number between 0.65 and 0.95. Through this manipulation, the participant's performance always appeared to be below average. In the positive comparison condition, the computer multiplied the participant's actual time value by a random number between 1.05 and 1.35 to calculate the average time for all participants. This manipulation always showed participant performance as above average. In order to improve the credibility of its feedback, the computer changed one of every five positive comparisons to a negative one and vice versa. When negative comparison information coincided with verbal praise, the computer matched the rounds in which the computer provided moderately negative verbal feedback with those in which it showed negative comparison information in order to maintain consistency. Finally, in the no comparison condition, the feedback screen did not show information on the average performance of all participants.

2.3.3. Agent embodiment manipulation

The game interface displayed a chat dialog interface to provide participants with game instructions and verbal feedback. This interface is illustrated in Fig. 1. The agent embodiment manipulation involved displaying or not displaying next to the chat dialog the picture of an embodied agent, particularly a Wakamaru robot, which served as an abstract, gender- and race-neutral character.

2.4. Procedure

Participants logged onto an online game software implemented in Adobe Flash. The first screen of the game interface asked participants to review and agree to a consent form approved by the University of Wisconsin–Madison Institutional Review Board. The interface then gave participants information on the purpose of the experiment and detailed instructions on the game task. In order to minimize demand characteristics, participants were told that the experiment examined the readability of different font types and sizes and that their performance in counting the number of occurrences of a letter in a sentence would measure font readability. The instructions also asked them to show their best performance, as these measurements needed to be extremely precise, and that measures were being taken to check whether they were purposefully taking too long or providing an excessive number of incorrect answers. Following the instructions, participants played the game until they decided to stop. After completing the game, they answered a post-experiment questionnaire that measured cognitive performance (perceived performance), intrinsic motivation, and demographic information.

3. Results

A fixed-effects multi-way ANOVA tested the hypotheses using intrinsic motivation (subjective measure) and task persistence (objective measure) as two dependent variables of user motivation. The data from the task persistence measure were transformed using the logarithm function to correct for the positive skew in its distributions and outliers without excluding data samples.

3.1. Praise and motivation

Hypothesis 1 predicted that people who received praise would be more motivated than people who did not receive praise. The analysis showed a main effect of praise on task persistence; participants who received praise played significantly more rounds of the game than participants who did not receive praise did, $F(1, 190) = 9.19$, $p = .003$, $\eta^2_p = .024$ (Table 1).

While the analysis did not find a main effect of praise on intrinsic motivation, $F(1, 188) = 1.04$, $p = ns$, $\eta^2_p = .003$, it found a significant interaction between praise and social comparison, $F(2, 188) = 3.84$, $p = .004$, $\eta^2_p = .030$ (Table 2). Pair-wise comparisons showed that participants who received praise reported significantly higher ratings of intrinsic motivation than participants who did not receive praise, $F(1, 188) = 8.78$, $p = .003$, $\eta^2_p = .063$, but only among those who did not receive social comparison information. Participants who received social comparison information were not affected by praise, $F(1, 188) = 0.67$, $p = ns$, $\eta^2_p = .003$. The effects of praise on motivation and task persistence are illustrated in Fig. 2.

3.2. Social comparison and motivation

Hypothesis 2 predicted that participants who received social comparison information would be more motivated to perform the task than those who did not receive social comparison information.

The analysis did not find a main effect of social comparison on task persistence or intrinsic motivation. However, as noted earlier, the analysis revealed an interaction between praise and social comparison on intrinsic motivation. Participants who were socially compared rated their intrinsic motivation to be significantly higher than whose who were not socially compared did, $F(1, 188) = 9.36$, $p = .003$, $\eta^2_p = .051$, but only with participants who did not receive praise. Participants who received praise were not affected by receiving social comparison information, $F(1, 188) = 1.06$, $p = ns$, $\eta^2_p = .005$. These effects are also shown in Fig. 3.

3.3. Cognitive performance, praise, and motivation

Hypothesis 3 predicted that participants who believe that they performed poorly would be more receptive to praise and be more motivated by praise than those who believe that they performed well would do. The testing of this hypothesis compared measures of motivation between participants in the positive comparison condition (high cognitive performance) and those in the negative comparison condition (low cognitive performance) among participants who received praise. The results showed a main effect of cognitive performance on task persistence. Of the participants who received praise, those who believed that they performed poorly persisted in the task significantly longer than those who believed that they performed well did, $F(1, 62) = 4.05$, $p = .049$, $\eta^2_p = .032$ (Fig. 4). Self-perception of performance did not have a significant effect on subjective measures of intrinsic motivation.

3.4. Presence of agent

Hypothesis 4 predicted that participants would be more motivated when an on-screen agent is present than when it is not. The analysis found a main effect of the presence of an on-screen agent on intrinsic motivation. Participants reported significantly higher levels of intrinsic motivation in the presence of the agent than they did in the absence of it, $F(1, 190) = 4.05$, $p = .046$, $\eta^2_p = .011$ (Table 3 and Fig. 5). The analysis found no significant effects of agent embodiment on task persistence.

3.5. Manipulation check

A one-way analysis of variance (ANOVA) tested the effectiveness of the praise and social comparison manipulations. Results showed that participants who received praise reported the computer's feedback to be significantly more praiseful than those who did not receive praise, $F(1, 190) = 27.10$, $p < .001$, $\eta^2_p = .067$. Information that compared participants' performance to those of others had a significant effect on their perception of their performance, $F(1, 189) = 7.93$, $p = .005$, $\eta^2_p = .018$. Participants in the positive comparison condition (high performance) reported significantly higher levels of performance than participants in the no comparison condition did, $F(1, 189) = 7.93$, $p = .005$, $\eta^2_p = .018$. Additionally, participants in the negative comparison condition (low performance) reported significantly lower levels of performance than participants in the no comparison condition, $F(1, 189) = 27.92$, $p < .001$, $\eta^2_p = .063$. These results confirmed that the experimental manipulations were effective.

4. Discussion

Hypothesis 1 predicted that users who receive praise (subjective feedback) would be more motivated to perform a task than those who do not receive praise would do. Hypothesis 2 predicted that users whose performances are compared against their peers (objective feedback) would be more motivated to perform a task than users whose performances are not compared against their peers. The results provide conditional support for both of these hypotheses and, more importantly, suggest that the two types of feedback—subjective and objective—interact.

Participants who received subjective feedback reported significantly higher levels of intrinsic motivation, but only when they did not receive objective feedback. Subjective feedback did not affect participants who did receive objective feedback. This result provides conditional support for Hypothesis 1. Additionally, participants who received objective feedback reported significantly higher levels of intrinsic motivation, but only when they did not also receive subjective feedback. Those who did receive subjective feedback were not affected by objective feedback. These findings offer conditional support for Hypothesis 2.

Hypothesis 3 predicted that users who believe that they performed poorly would respond more positively to praise than users who believe that they performed well would do. The results supported this hypothesis. Users who believed that they performed poorly and were praised persisted in the task significantly longer than those who believed that they performed well did. Additionally, of the participants who received praise, low-performers persisted significantly longer than high-performers did.

Hypothesis 4 predicted that users would be more motivated to perform the computer-based task when an on-screen agent is present than they would be when no on-screen agent is present. The results support this hypothesis; users who performed the task in the presence of an abstract, gender- and race-neutral on-screen agent reported significantly higher levels of intrinsic motivation than those who performed the task when no on-screen agent was present did.

Table 4 provides a summary of all hypotheses and indicates whether or not the data from the primary outcome measures support them.

4.1. Implications of the results

The findings suggest that users must have some measure for evaluating their performance in order to sustain intrinsic motivation. When users have no way of evaluating their performance, they lose motivation. The current experiment provided users with four ways to evaluate their performance: no feedback, subjective feedback (praise), objective feedback (comparison), or both. Users who did not receive feedback had no way of evaluating how well they were doing, and thus reported the lowest levels of intrinsic motivation. Users who did receive feedback, no matter if it was subjective or objective, had a metric for evaluating their performance, and thus reported an increase in intrinsic motivation. The somewhat surprising finding is that the type of feedback did not affect motivation; subjective feedback benefited users just as much as objective feedback did. Furthermore, the effect was not additive; that is, giving both subjective and objective feedback at the same time did not provide any additional increase in motivation.

The results also suggest that positive interpersonal feedback or praise from a computer is an effective motivator when users are performing poorly, but not when they are performing well. Users who know that they are performing well do not need praise, while those who know that they are performing poorly benefit from it.

Although these results suggest that computers should provide users with praise even when they are performing poorly, this approach might have some drawbacks. Research on motivation suggests that praise is most effective when it is contingent, specific, sincere, and credible (O'Leary & O'Leary, 1977). Praise that is not contingent on task-related performance has been shown to be detrimental to intrinsic motivation in classroom settings, because it may highlight the student's poor performance and cause embarrassment (Brophy, 1981). Although praise that the users received in the current experiment was not always contingent to their task-related performance (i.e., poor performers could also receive praise), the results showed no negative effects of praise on user motivation. This finding could be a result of the solitary nature of the computer-based task used in the current study; unlike students in the social setting of a classroom, the users of the computer-based task were typically alone and, thus, praise that was not contingent on their task-related performance might not have called peer attention. This explanation is also consistent with the disparity in findings between the HCI and education literatures; praise that is not contingent on task performance has a positive effect on motivation in computer-based tasks (Fogg & Nass, 1997), but a negative one in classroom-based tasks (Brophy, 1981; O'Leary & O'Leary, 1977).

The results of the current study also suggest that humanlike embodiment, even in rudimentary representations, can serve as a motivational tool in persuasive interfaces. While more sophisticated representations that enable the use of a wider range of human verbal and nonverbal communicative capabilities through speech synthesis and animation might offer richer user experiences and further motivate users, implementing such representations is not trivial. Instead of choosing between sophisticated embodied humanlike representations and no humanlike representations, designers of motivational interfaces should consider using simple agent representations to deliver instructions and feedback.

4.2. Limitations

The results presented here have a number of limitations. First, the participants were recruited through Amazon.com's Mechanical Turk online marketplace, which might not provide us with a representative sample of all computer users (Ipeirotis, 2010), potentially limiting the generalizability of the results of this investigation to the general population. Second, the present study did not investigate the possible long-term negative effects of praise. Praise over time might cause individuals to rely on praise as a motivator and replace intrinsic motivation (Montessori, 1964). Further investigation is needed to gain a better understanding of the long-term effects of praise from a computer on user motivation. Finally, although the scales used to measure intrinsic motivation have been previously validated, they may not serve as accurate predictors of long-term task adherence, which is the ultimate goal of motivating users. Future research could employ repeated trials with objective measures to better assess the longterm effects of computer feedback on adherence.

5. Conclusion

The present work investigated how praise, social comparison, and humanlike embodiment might increase user motivation and task persistence in a computer-based task. Its results have several implications for the design of motivational user interfaces. First, these interfaces must provide users with some measure for evaluating their performance on a task; they might otherwise lose motivation. The results showed that users who did not receive any feedback on their performance reported the lowest levels of intrinsic motivation. Furthermore, users benefit from any type of feedback—both subjective (praise) and objective (social comparison) feedback resulted in similar increases in motivation. Providing users with both types of feedback, however, did not show any additional increases in motivation. Second, users' perceptions of how well they are performing affect how they respond to praise. Among users who received praise from the computer, those who believed that they performed poorly persisted in the task longer than those who believed that they performed well did. Finally, the results showed that even an abstract, static embodied agent positively affects user motivation. Motivational interfaces that draw on such representations of humanlike embodiment might enhance the social presence of the interface, increase the user's drive, and improve task performance.

Appendix A

Intrinsic motivation scale items (Guay et al., 2000):

1. I am engaged in this activity because I think that this activity is interesting.
2. I am engaged in this activity because I think that this activity is pleasant.
3. I am engaged in this activity because this activity is fun.

4. I am engaged in this activity because I feel good when doing this activity.

Appendix B

Sample sentences displayed to the participants in the game:

The stranger spells a produced photograph.
A cleared parameter works past a meal.
The agreed cap eggs the motivated ballet.
A master piece pours a dominating imbalance.
The blast deprives every minor mathematics.
A postcard conforms before the fringe public.
When will the technique pray an expressed employer? A spy participates across a murder.

Appendix C

The script that the computer used for game instructions:

"Hello, participant."
"I am interested in seeing how fast humans can scan written text at different font sizes."
"Today, I will be timing you on how fast you can count the times a letter appears in a given sentence."
"Soon, a sentence will appear on the right. I will tell you a letter and you must count how many times it appears in the paragraph as fast as you can."
"As soon as you know the exact count, enter it in the text box and press the Submit button. Your answer will only be submitted if it is correct."
"In order to complete the requirements for the experiment, you must do this for five sentences. However, you are welcome to continue performing the task as many times as you'd like." "After your fifth time, an "I am done" button will appear. Press this button when you want to stop."

"You must do your best to be as fast as possible. If you are purposefully taking too much time or submitting excessive incorrect answers, you may not receive payment."

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