The Effects of Animated Characters on Anxiety, Task Performance, and Evaluations of User Interfaces

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ABSTRACT
Animated characters are common in user interfaces, but important questions remain about whether characters work in all situations and for all users. This experiment tested the effects of different character presentations on user anxiety, task performance, and subjective evaluations of two commerce websites. There were three character conditions (no character, a character that ignored the user, and a character that closely monitored work on the website). Users were separated into two groups that had different attitudes about accepting help from others: people with control orientations that were *external* (users thought that other people controlled their success) and those with *internal* orientations (users thought they were in control). Results showed that the effects of monitoring and individual differences in thoughts about control worked as they do in real life. Users felt more anxious when characters monitored their website work and this effect was strongest for users with an external control orientation. Monitoring characters also decreased task performance, but increased trust in website content. Results are discussed in terms of design considerations that maximize the positive influence of animated agents.

Keywords
Animated characters, social agents, social facilitation, locus of control.

INTRODUCTION
The history of ideas about animated characters in human-computer interaction is turning a corner. Initial debates concerned the presence of any character performing any kind of behavior. The questions were whether animated characters—as a general concept in interfaces—were good or bad, useful or useless. These debates rarely yielded an answer more satisfying than—"it depends." As has been the case with the introduction of all new media in the 20th century, the initial debate was framed too aggressively to lead to useful answers. The most accurate summary about the impact of all media—film, radio, television, and the internet—is that some effects occur for some people, in some conditions, and for some types of content. The trick in research is to find out which effects, which people, which situations, and which content.

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An elaboration of the conditions for animated characters to succeed is underway. There are several new studies that demonstrate the potential for animated characters to automate social interactions in ways that make computing more pleasing, productive, and easy. Research has focused on, for example, character appearance [19, 15], non-verbal behavior [6, 17], personality [12, 31], emotion [3, 4], and speech characteristics [20]. This research is important given the increasing use of animated characters in products and services ranging from search engines to shopping "bots" to virtual employees in commerce transactions.

This experiment tested two new ideas about animated characters that further elaborate our understanding of when and how they affect human-computer interaction. First, we examined whether animated characters have enough social presence—even if virtual—to make users feel that they are being monitored. Second, we examined whether people who respond strongly to the presence of others (because they hold a general belief that others control their destiny) respond differently to animated characters than people who are less affected by the presence of others.

Our ideas about how people would respond to the presence of animated characters came from two significant literatures in psychology. The literature on social facilitation describes how people respond to the presence of others while they work, and how this response is related to the perception of being monitored. The literature on locus of control addresses how individual differences in people's thoughts about personal control affect their reactions to the presence of others. We will briefly review each of these literatures and describe how we used them to study the effects of animated characters on commerce websites.

Social facilitation
Sometimes it's nice to have company—a real person—when you work. Imagine, however, that you're working on a hard problem. Someone enters the room,

takes a seat across from you, and starts to thumb slowly through a magazine. Would the mere presence of this person make you anxious or affect your ability to complete the task at hand? What if the person walked over and stood behind your shoulder to get a better look at what you're doing?

Research on social influence provides answers to these questions. There is strong evidence that the mere presence of another person increases anxiety and lowers levels of performance on complex tasks [33, 9]. If the other person is in a position to evaluate performance, such "social facilitation" effects are strengthened [7, 23].

One explanation for how social facilitation works is Zajonc's [33] drive theory. Zajonc thought that the presence of other people creates a state of increased arousal or generalized drive. The drive produced by the presence of others is an alertness for the unexpected, a preparation to respond to the actions of others. Zajonc thought that drive could be generated by the presence of anyone who has the potential to be active, regardless of the other persons ability to evaluate, reward, or punish.

Cottrell [7] argued, however, that the mere presence of other people is not sufficient, in and of itself, to increase drive. Rather, it is the anticipation of positive or negative outcomes that are associated with the presence of others that cause heightened arousal. Cottrell [8] tested this idea in an experiment where people either completed a task alone, under the attentive gaze of two spectators, or in the presence of two people who were blindfolded. As predicted, the condition in which there were spectators decreased performance, but there was no effect on performance when people were alone or in the presence of people who couldn't see their work [8].

While there is some debate about whether the mere presence of others is sufficient to increase arousal and diminish performance, the conclusion from this literature is clear in those cases when a social actor communicates an intention to monitor someone's work. When the monitoring is obvious, thoughts and behavior change. There is more anxiety and less accurate performance of complex tasks.

Locus of control

Now imagine two different people being monitored while they work on a complex task. The first person believes that she controls her own destiny and that other people have little to do with whether she fails or succeeds. The second person is convinced, however, that he is at the mercy of forces which he doesn't control and that his success depends on the help of others. Would you expect these people to respond differently when someone watches them work?

The answer from research is that you should expect differences. Being monitored is less worrisome for people who believe that they control their own destiny than for those who think that their destiny is in the hands of others. In other words, it depends upon the person's "locus of control" [27, 25, 9]. People tend toward either an *internal* or an *external* locus of control [27]. Those who have an internal locus of control are inclined to believe that rewards are contingent upon their own behavior, whereas those with an external locus of control tend to believe that their fate is either in the hands of others or a product of chance [27, 16, 18].

Several studies indicate that people with an external locus of control have a greater tendency to be influenced by social stimuli in their environment, and to modify their behavior in accordance with the responses and evaluations of others, than people with an internal locus of control [9, 16, 30]. This effect is particularly strong when people perform tasks that are complex or unfamiliar, such as novel math problems. When the locus of control is internal, an audience is no bother; when the control orientation is external, performance suffers [2, 25].

Social reactions to animated characters

Now, keeping in mind the relationship between monitoring and locus of control discussed above, substitute an animated character for the presence of another person. The character is either reading idly in a corner of your computer screen or monitoring your every move as you work on a complex web task. Would your reactions to the animated character be similar to a real person?

There is good reason, from two sources, to assume that this would be the case. First, several studies have found that monitoring can have social effects when electronic equipment is substituted for the presence of real people. In these studies, there is no explicit social actor present, but the results of the research still hold.

Aiello and Svec [2] reported the first empirical demonstration of social facilitation effects in a context that involved electronic monitoring. They showed that complex task performance was impaired for people who are monitored electronically just as for those who were monitored in person. They also showed that people with an external locus of control were more anxious about their performance than those with an internal locus of control, regardless of whether they were monitored interpersonally or electronically, but less anxious than those with an internal locus of control when no monitoring was involved.

Other experiments about electronic monitoring support and extend the conclusions of Aiello and Svec [2]. Kolb and Aiello [1] reported that electronic monitoring decreased task performance and increased anxiety, but that the effects on anxiety can be lessened if people think that they are members of a cohesive workgroup. Stanton and Barnes-Farrell [29] found the same negative effects of electronic monitoring, but also found that the effects can be averted if people perceive that they have the ability to prevent or delay the monitoring—even if they do not exercise this control.

The fact that electronic monitoring often involves evaluation by another person, even if they are not physically present, may signal caution in applying these studies to animated characters. There is a significant body of research, however, that suggests that the psychology of human-human relationships can be applied directly to virtual social actors and their interactions with users. This is not to suggest that people would confuse animated

characters with real people, but simply that interactions with such characters may inherently trigger responses that have been well-rehearsed during a lifetime of social relationships.

There is now a substantial body of evidence that adults regularly respond to technology such as computers in a social manner [26, 21]. People develop affiliations with computer "teammates" in a similar manner to the way in which they develop group affiliations with humans [22]. Likewise, people respond to praise and criticism from computers as they respond to these assessments from humans [24, 10], and people are courteous when critiquing computers even though they "know" that computers have no feelings to be hurt [21]. Such interactions with computers are not deliberate, but instead mindless and automatic. Animated characters elicit similar responses.

People confer human personalities upon the simplest of animated characters [14, 26]. Rather than seizing on the differences between such characters and humans—a process that requires thought or deliberation—people slip into social conventions because important features of interactions with animated characters mimic real life. And the more that animations look and act like humans, the stronger this anthropomorphic tendency [23, 11].

Our hypotheses about responses to animated characters follow directly from the psychological literature we reviewed. We expected that the mere presence of such characters would increase the anxiety and decrease the performance of users working on complex tasks. Furthermore, we expected that these effects would be heightened if the animated characters displayed monitoring behavior. We also expected that these effects would be moderated by the locus of control of users. Those with an external locus of control were expected to react more strongly to the animated characters than users with an internal locus of control. In addition to these expectations, we also assessed subjective responses to the context (websites) in which interactions with the animated characters took place. While no previous work has extended social facilitation effects to evaluations of context, ways in which the likability, ease of use, and trustworthiness of websites are affected by animated characters are important to understand—especially in regard to the commercial contexts used in this experiment.

EXPERIMENTAL METHODS

Subjects. Eighty-four people participated in the experiment (60% male and 40% female). An additional 20 people were used to pretest stimulus materials. All subjects were either undergraduate or graduate students recruited at Stanford University. All were experienced computer users (i.e., they knew how to word-process and manage a UNIX email account).

Experimental Design. The experiment was a between-subjects, full-factorial two-by-three design. The two factors were (1) the subjects' locus of control and (2) the monitoring activity of an animated character.

Locus of control was either Internal or External. Forty-two subjects with an internal locus of control and 42 subjects with an external locus of control were chosen from a pool of 159 potential subjects on the basis of a pretest. The monitoring factor consisted of three levels: No Character, Idle Character, and Monitoring Character. Subjects in the No-Character condition completed a series of computer tasks with no animated character present. Subjects in the Idle-Character condition completed the identical tasks, but with an animated character present in the lower right-hand corner of computer screen. This character never made "eye contact" with subjects and appeared to ignore all activity as the tasks were completed. Subjects in the Monitoring-Character condition also had an animated character present on their computer screen as they completed identical tasks, but in this condition the character appeared to look at both the user and at the webpages that users were working on. The character in the Monitoring condition also periodically took photographs of these webpages and took notes on a pad when users submitted information regarding their tasks.

Locus of Control Pretest. Rotter's [27] Locus of Control Scale was used to determine the internal versus external orientations of potential subjects. This instrument consists of 23 forced-choice items that each present a pair of statements. In each pair, one statement expresses an internal viewpoint and the other an external viewpoint. Respondents completed the scale by indicating which of the two statements they agreed with most. The following pair of statements is typical items on the scale:

(a) *Sometimes I can't understand how teachers arrive at the grades they give.*
(b) *There is a direct connection between how hard I study and the grades I get.*

Scores on this scale can range from 0, indicating that no external statements are endorsed, to 23, indicating that all external statements are endorsed. The mean score on the pretest was 13.27 (SD = 3.8). Only the 42 subjects that scored lowest (internal) and highest (external) on the pretest were selected to participate. A two-tailed t-test indicated that the scores on the Locus of Control scale for these two groups was significantly different ($t(82) = 18.47$, $p < .001$).

Stimulus Material. The stimulus material consisted of two primary components: the animated characters that comprised the distinction between the Idle-Character and Monitoring-Character conditions and the web-based tasks that all subjects completed during the experiment.

The animated characters were specially developed for this experiment using Microsoft Agent software. The characters used in both the Idle-Character and the Monitoring-Character conditions were based upon Microsoft's "Genius" animations, so their physical features were identical (see Figure 1 for an illustration). The characters were approximately 1.5" tall (1152 x 870 resolution) and appeared in the lower-left corner of the Microsoft Explorer 4.5 browser that people used to view the web pages.

The only distinctions between the idle and monitoring characters lay in the repertoires of their movements and the degree to which these movements were contingent upon the

subjects' behavior on the websites. The idle character periodically stretched, scratched his head, and rubbed his eyes, but generally appeared to be preoccupied by reading a book. None of this character's movements or gestures were contingent on the subject's behavior. This was meant to strengthen the perception that it was not paying attention to the subject.

The monitoring character appeared to be watching the subject and would glance at webpages on which the subject was working when the cursor was moved over information pertinent to the tasks. As mentioned above, this character also appeared to take photographs and notes as the user entered information.

Figure 1: Examples of the Monitoring Character (Top Row) and Idle Character (Bottom Row).

Two different websites were created for the experiment. The goal was to provide two prototypical web transactions that required users to solve problems. One of the websites was based upon the Charles Schwab website and the other was based upon the Dell Computer website. Both of these sites were served locally in order to ensure consistent download times as well as track user performance. Subjects viewed the websites above a frame that contained instructions for each task as well as a text field used to submit solutions to the tasks.

The tasks assigned to users included finding specific information, comparing products, and completing forms used to personalize products. Because task difficulty has been identified as a variable that moderates social facilitation [7, 8], it was important to ensure that the tasks were difficult. It was also desirable to balance the level of task difficulty across the two websites in order to facilitate comparisons. This was accomplished by pretesting ten different tasks (with a separate sample of people) and selecting six that were of comparable difficulty (three for each website).

Twenty subjects participated in the task-difficulty pretest. People were given a paper questionnaire that described five tasks on the Dell Computer website and five tasks on the Charles Schwab website, and that contained items to rate the difficulty of these tasks. After finishing each task, subjects completed five 10-point Likert scales that assessed: complexity, confusion, ease, effort, and thought required for the previous task. A Difficulty index was created from these five items (*alpha* = .95) and used to rate the ten tasks. Three tasks on each website were retained for the primary experiment on the basis of this task-difficulty index. A two-tailed *t*-test showed that the three tasks retained for the Dell Computer website and the three tasks retained for the Charles Schwab website were not significantly different in terms of difficulty ($t(19) = .59$, p = N.S.).

Apparatus. The computers used in the primary experiment were identical Hewlett Packard 440 mhz Kayak XWs with 21" color monitors (1152 x 870 resolution). These computers also had identical keyboards and mice, but were located in different experimental labs. The two labs were similar in terms of size and furnishings and use of the two labs was balanced across conditions.

Procedure. After arriving at a prescheduled time, people were brought to one of the labs in which the experiments were run and given a questionnaire. An experimenter then read an introductory script that was identical for all subjects before leaving the room.

People read specific instructions for each task in a frame that appeared at the bottom of their web-browser. When they found a solution to a task, they keyed their response into a text field in the frame and selected a *Submit* button. This brought up the instructions for the next task.

Half of the subjects worked on the Charles Schwab website and half worked on the Dell Computer website. Before they answered questions about either site, they were asked to view the other site. This was done to give each user experience with their character condition so that they would be introduced to the level of monitoring that would occur when the experiment began.

Anxiety Measure. Anxiety was assessed using a modified version of Speilberger, Gorsuch, & Lushene's [28] State Anxiety Scale. The items were answered on four-point Likert scales on a paper questionnaire. The following items exemplify those that appear on the questionnaire: *I felt calm; I felt secure; I felt strained;* etc.

Performance Measure. Performance was measured by adding the number or tasks completed correctly. The computers used in the experiment recorded people's answers for each task. Performance was calculated on the basis of logfiles compiled by these computers. Tasks included comparing the performance of various mutual funds, configuring computer hardware, etc.

Website Evaluations. Subjective evaluations of the two websites were measured with a sixteen-item questionnaire. Subjects were asked to note their degree of agreement with each of the statements on ten-point Likert scales. Factor analysis was used to build three indices from the total set of items. The first, *Likability*, accounted for 40.4 percent of the variance and included items that assessed levels of enjoyment, fun, and boredom as well as willingness to recommend, expected future use, and likelihood of making

purchases. The second factor, *Ease of Use*, accounted for 13.7 percent of the variance and included items that assessed levels of confusion and frustration as well as perceptions concerning the ease of making mistakes, the level of user control, and the quality of the design. The final factor, *Trustworthiness*, accounted for 10.7 percent of the variance and included items concerning objectivity and the degree to which content was opinionated.

Manipulation check. The manipulation check was an index of three items answered by all people who were in one of the conditions that involved characters. People were asked whether the character seemed to be *watching* them, whether the character seemed to *record* their answers, and whether the character seemed to be *judging* them. These items were used to form a Monitoring Index that had a Cronbach's *alpha* of .70.

The manipulation was successful. A planned one-tailed *t*-test on the Monitoring Index showed that subjects in the Monitoring-Character condition reported a higher level of monitoring than subjects in the Idle-Character condition ($t(52) = 4.49$, $p < .001$).

RESULTS

Full factorial ANOVAs were performed on all measures. A summary of these ANOVAs appears in Table 1. The planned tests of all hypotheses are discussed in detail below, as are results pertaining to the relationship of animated characters and locus of control to the evaluation of the websites.

Table 1: Summary of ANOVAs for Dependent Variables

	Independent Variables		
	Character	Locus of Control	Interaction
Anxiety	10.85***	17.09***	3.12*
Accuracy	6.83**	.86	.50
Likability	.16	5.21*	.62
Ease of Use	.76	.05	.68
Trustworthy	3.81*	4.96*	2.42†

*$p < .05$ **$p < .01$ ***$p < .001$ †$p = .10$

Note: All *F* values for Locus of Control have degrees of freedom $F(1, 83)$, all others have $F(2, 83)$.

Anxiety

As can be seen in Table 1, levels of anxiety differed across the character manipulation ($F(2, 83) = 10.85$, $p < .001$). The mere presence of a character generated more anxiety than no character, but the most anxiety was caused by the monitoring character. Levels of anxiety also varied across the locus of control manipulation ($F(1, 83) = 17.09$, $p < .001$). The most important part of these results, however, is the interaction of the character and locus of control conditions ($F(1, 82) = 3.12$, $p < .05$). The level of anxiety was highest for external subjects who were monitored and lowest for internal subjects who did not see a character.

Figure 2 shows the results for anxiety. One-tailed, *a priori* contrasts showed that people were more anxious when an idle character was present than when no character was present ($t(72) = 1.4$, $p = .08$). Also, people were more anxious if an animated character appeared to monitor them than if no character was present ($t(72) = 4.6$, $p < .001$). And people were more anxious if an animated character monitored them than if an idle character was present ($t(72) = 4.6$, $p < .001$). Users with an external locus of control were also more anxious when monitored by an animated character than were users with an internal locus of control ($t(72) = 4.6$, $p < .001$).

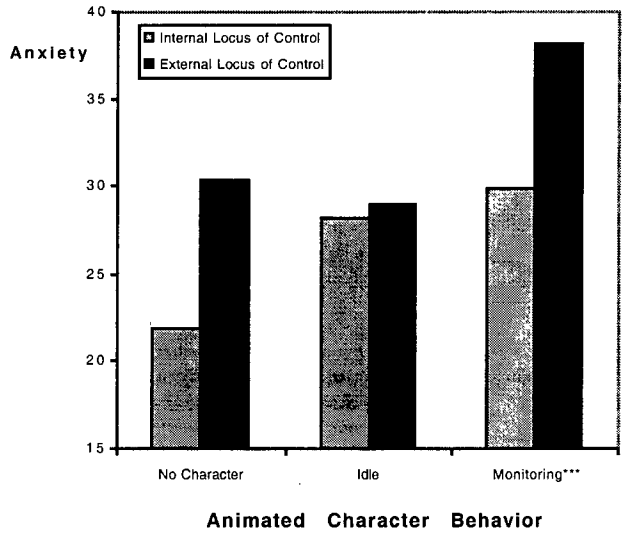

Figure 2: Level of Anxiety in the No Character, Idle Character, Monitoring Character, and Internal as well as External Locus of Control Conditions

Performance

The character manipulation had a significant main effect on the accuracy with which subjects performed tasks ($F(2, 83) = 6.83$, $p < .01$), but as can be seen in Table 1, there were no differences for locus of control nor an interaction effect.

The means for each condition are shown in Figure 3. *A priori* contrasts showed that users completed fewer tasks accurately when they were monitored by an animated character than when no character was present ($t(72) = 4.6$, $p < .01$) or when an "idle" character was present ($t(72) = 3.7$, $p < .001$).

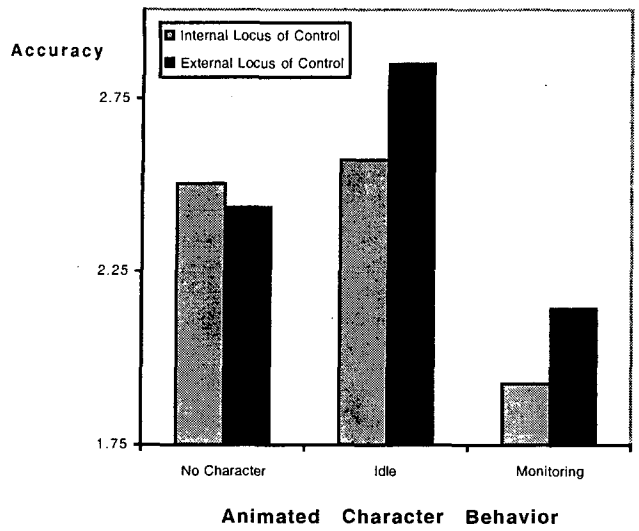

Figure 3: Accuracy in the No Character, Idle Character, Monitoring Character, and Internal as well as External Locus of Control Conditions

Website Evaluations

There were three separate indices (constructed from a factor analysis of all evaluation items) that summarized user's subjective judgments about the websites.

Likability. Locus of control had a significant main effect on the degree to which people liked the websites ($F(1, 83) = 5.21$, $p < .05$). Users with an internal orientation (i.e., those that thought they controlled their own success) liked the websites more than those with an external orientation, especially when there was no character present (Figure 4).

The character manipulation had no significant main effect on liking, and it did not interact with locus of control.

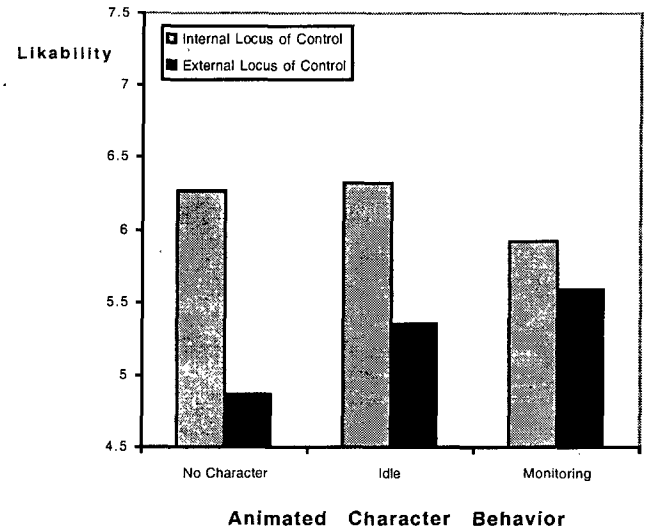

Figure 4: Likability of Website in the No Character, Idle Character, Monitoring Character, and Internal as well as External Locus of Control Conditions

Ease of Use. The evaluations for ease of use showed little change across the experimental conditions (Figure 5). No statistically significant differences were found, either for character or locus of control.

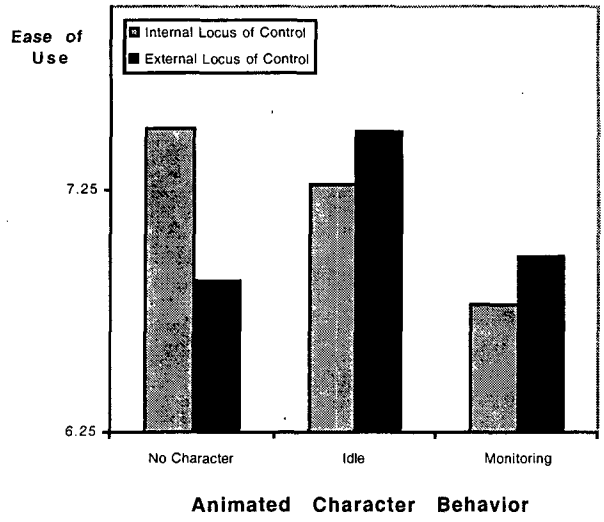

Figure 5: Ease of Use of Website in the No Character, Idle Character, Monitoring Character, and Internal as well as External Locus of Control Conditions

Trustworthiness. The character manipulation had a significant main effect on judgments of trustworthiness ($F(2, 83) = 3.81$, $p < .05$) such that people in the monitoring condition trusted the websites the most, and people who saw no character trusted the website the least (Figure 6). *Post hoc* contrasts showed that the mean level of trust in the Monitoring condition was significantly higher than that in the No-Character condition ($t(83) = 1.2$, $p < .05$).

Locus of Control also affected trustworthiness ($F(1, 83) = 4.96$, $p < .05$) such that people with an internal orientation trusted the websites more than externally oriented people.

The major result, however, is the interaction of character presence and locus of control ($F(2, 83) = 2.42$, $p < .1$), which suggests that internals trusted the websites more than externals, but only in the No-Character and Monitoring-Character conditions.

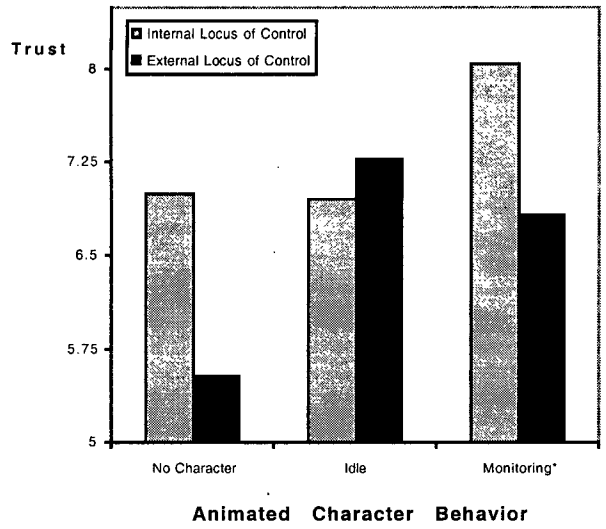

Figure 6: Trustworthiness of Website in No Character, Idle Character, Monitoring Character, and Internal as well as External Locus of Control Conditions

DISCUSSION

The perception of being monitored by an animated character has the same effects on Anxiety and Performance as being monitored by a human, either electronically or in person. When a character watches, users are more likely to feel anxious about their work and to perform less well. This anxiety is most pronounced among users who think that other people control their success.

At the most general level, these results suggests that decisions concerning the use of animated characters should address the details of execution and social presentation. It is not sufficient–for celebration or condemnation–to focus on whether or not an animated character is present. Rather, the ultimate evaluation is similar to those for real people–it depends on what the character does, what it says, and how it presents itself. The effects of animated characters are not unilaterally good or bad; they can be either or both. Using an animated character turns up the volume on social presence, which means that it can accentuate the effects of everything presented.

The possible relationship between anxiety and positive outcomes (in this study increased trustworthiness) is an interesting case in point. Anxiety should not be considered only as a negative response. Anxiety is arousal, the engine of many things psychological. Arousal can determine where we focus our attention as well as what we remember [13]. Highly arousing things can be good or bad (e.g. sexual arousal vs. arousal from witnessing gory surgery), so it should be considered independently of valance.

The conclusion is that *some* arousal in an interface may be useful, a finding consistent with the best preparation methods for exams in school. You don't want to be bored or aroused to the point of distraction–just aroused enough that you pay attention and remember. Characters in interfaces may help designers reach this middle ground. If their presence is executed well, they can increase interest (and a little anxiety) in ways that enhance desirable social responses. In the specific case of trustworthiness, it is easy to imagine, for example, that a financial advisor looking over your shoulder in real life might increase your level of anxiety about money and, thereby, raise your evaluation of the value of his or her advise.

The other significant effect in this study came from the assessment of locus of control. This concept is a new addition to interface research that may help separate those who like and don't like animated characters. There is significant disagreement about the value of animated characters in interfaces, especially in commentary and reviews. Some of these differences in opinion might be explained by internal versus external orientations. Interface designers may want to avoid using animated characters when they know that they are designing for people with an internal locus of control (i.e., when users are confident that they can complete work on their own). The addition of characters may make interactions more robust, however, when users perceive that they lack control over their success. The important thing to remember is that such decisions concerning the use of animated characters should be based on users' (relatively stable) traits regarding perceptions of control rather than on fleeting reactions to a task at hand.

These and other insights point to the value of conceptualizing interaction with computers in terms of interpersonal interaction. One way for designers to develop characters is to reflect on the nature of relationships between people. This study shows that some of the underlying dynamics of such relationships (perceptions that others are paying attention and feelings regarding control) also affect reactions to animated characters. The important conclusion is that these dynamics can be useful when applied to interactions with computers. Having a social actor look over your shoulder–animated or real–is cause for notice.

REFERENCES

1. Aiello, J.R. & Kolb, K.J. (1995). Electronic performance monitoring: A risk factor for workplace stress. In S. Sauter & L. Murphy (Eds.), *Organizational Risk Factors for Job Stress.* Washington, DC: American Psychological Association.
2. Aiello, J.R. & Svec, C.M. (1993). Computer monitoring of work performance: Extending the social facilitation framework to electronic presence. *Journal of Applied Psychology, 23(7).*
3. Ball, G. & Breese, J. (1998). Emotion and personality in a conversational character. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
4. Becheiraz, P. & Thalmann, D. (1998). A behavioral animation system for autonomous actors personified by emotions. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
5. Bond, C.F. & Titus, L.J. (1983). Social facilitation; A meta-analysis of 241 studies. *Psychological Bulletin, 94(2).*

6. Cassell, J. & Thórisson, K.R. (1999). The power of a nod and a glance: Envelope *vs.* emotional feedback in animated conversational agents. *Applied Artificial Intelligence, 13.*
7. Cottrell, N.B. (1972). Social Facilitation. In C.G. McClintock (Ed.), *Experimental Social Psychology.* New York: Holt, Rinehart, & Winston.
8. Cottrell, N.B., Wack, D.L., Sekerak, G.J., & Rittle, R.H. (1968). Social facilitation of dominant responses by the presence of an audience and the mere presence of others. *Journal of Personality and Social Psychology, 9.*
9. Crown, D.P. & Liverant, S. (1963). Conformity under varying conditions of personal commitment. *Journal of Abnormal and Social Psychology, 66.*
10. Fogg, B.J. & Nass, C.I. (1997). Silicon sycophants: Effects of computers that flatter. *International Journal of Human-Computer Studies, 46.*
11. Isbister, C. & Layton, T. (1995). In J. Nielsen (Ed.), *Advances in Human-Computer Interaction, Volume 5.* Norwood, NJ: Ablex Publishing Corporation.
12. Isbister, C. & Nass, C.I. (1998). Personality in conversational characters: Building better digital interaction partners using knowledge about human personality preferences and perceptions. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
13. Lang, P.J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist, 50(5).*
14. Laurel, B. (Ed.). (1990). *The Art of Human-Computer Interface Design.* Reading, MA: Addison-Wesley.
15. Lee, E-J. & Nass, C.I. (1998). Does the ethnicity of a computer agent matter? An experimental comparison of human-computer interaction and computer-mediated communication. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
16. Lefcourt, H.M. (1966). Internal versus external control of reinforcement: A review. *Psychological Bulletin, 65(4).*
17. Lester, J., Towns, S., Callaway, C., & FitzGerald, P. (1998). Deictic and emotive communication in animated pedagogical agents. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
18. Martin, S.A. & Knight, J.M. (1986). Social facilitation effects resulting from locus of control using humans and computer experimenters. *Computers in Human Behavior, 1.*
19. Massaro, D.W. (1998). Perceiving Talking Faces: From Speech Perception to a Behavioral Principle. Cambridge, MA: MIT Press.
20. Nass, C. & Gong, L. (in press). Maximized modality or constrained consistency? Proceedings of the AVSP 99 Conference, Santa Cruz, CA.
21. Nass, C.I., Moon, Y., Morkes, J., Kim, E-Y., & Fogg, B.J. (1997). Computers are social actors: A review of current research. In B. Friedman (Ed.), *Human Values and the Design of Computer Technology.* Stanford, CA: CSLI Publications.
22. Nass, C., Fogg, B.J., & Moon, Y. (1996). Can computers be teammates? Affiliation and social identity effects in human-computer interaction. *International Journal of Human-Computer Studies, 45.*
23. Nass, C., Moon, Y., Fogg, B.J., Reeves, B.J., & Dryer, D.C. (1995). Can computer personalities be human personalities? *International Journal of Human-Computer Studies, 43.*
24. Nass, C., Steuer, J., & Tauber, E.R. (1994). Computers are social actors. In *CHI '94 Conference Proceedings.*
25. Pines, H.A. (1973). An attributional analysis of locus of control orientation and source of informational dependence. *Journal of Personality and Social Psychology, 26(2).*
26. Reeves, B. & Nass, C. (1996). *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places.* Stanford, CA: CSLI Publications.
27. Rotter, J.B. (1966). Generalized expectancies for internal versus external locus of control of reinforcement. *Psychological Monographs: General and Applied 80(1).*
28. Spielberger, C.D., Gorsuch, R.L., & Lushene, R.E. (1970). *Manual for the State-Trait Anxiety Inventory.* Consulting Psychologists Press, Palo Alto CA.
29. Stanton, J.M. & Barnes-Farrell, J.L. (1996). Effects of electronic performance monitoring on personal control, task satisfaction, and task performance. *Journal of Applied Psychology 81(6).*
30. Strickland, B.R. (1965). The prediction of social action from a dimension of internal-external control. *Journal of Social Psychology 66.*
31. Taylor, I.C., McInnes, F.R., Love, S., Foster, J.C., & Mervyn, J. (1998). Providing animated characters with designated personality profiles. *Proceedings of the 1998 Workshop on Embodied Conversational Characters.*
32. Weiss, R.F. & Miller, F.G. (1971). The drive theory of social facilitation. *Psychological Review, 78.*
33. Zajonc, R.B. (1965). Social Facilitation. *Science 149.*