On Manipulating Nonverbal Interaction Style to Increase Anthropomorphic Computer Character Credibility

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ABSTRACT

This study examined the effectiveness of enhancing human-agent interaction through the use of nonverbal behaviors. A taxonomy is described, which organizes nonverbal behaviors into functional categories and the manner in which they can be embodied (i.e. through gesture, posture, paralanguage, eye contact and facial expression). Prototype computer characters were created according to guidelines extracted from the taxonomy and their efficacy was empirical evaluated. The results indicate that by including trusting nonverbal behaviors, the perceived credibility of a computer character was enhanced, although addition of trusting bodily nonverbal behavior provided little in addition to trusting facial nonverbal behavior. Perhaps more importantly, a character expressing non-trusting nonverbal behaviors was perceived to be the least credible of all characters examined (including a character that expressed no nonverbal behavior). Participants that interacted with this persona perceived the task to be more demanding, made significantly more errors, and rated their interaction less positively and more monotonous than those using trusting personas. They also rated this character to be less likable, accurate, and intelligent. Taken together, the results from this study suggest that there may indeed be benefit to endowing computer characters with nonverbal trusting behaviors, as long as those behaviors are accurately and appropriately portrayed. Such behaviors may lead to a more trusting environment and positive experience for users. Negative character behavior, however, such as non-trusting behavior, may squander the advantages that embodiment brings.

Keywords
Embodied Conversational Agents; Nonverbal Behavior; Taxonomy of Nonverbal Behavior; Design Guidelines for Agent Embodiment.

1. INTRODUCTION

Computer technology is now a crucial element that holds together the social fabric of our lives. An increasing number of people have to interact with computers each day – smart, intelligent people who enjoy a thrilling, satisfying life but can't set the clock on their VCR or have problems with ATMs. Many seek a more natural means of communicating with their computers, a manner that makes interaction with a computer as easy as interacting with other people, taking advantage of the multimodal nature of human communication. Such interfaces have been designed and implemented and while users should, in theory, gravitate to such anthropomorphic embodiments, quite the contrary has been experienced; users generally have been dissatisfied, frustrated and eventually abandoned their use, Microsoft Bob and the set of Microsoft Office Assistants being famous examples [1]. This suggests a disconnect between factors that make human-human communication engaging and those used by designers to support human-agent interaction. Some researchers [2][3] believe this disconnect may be due to the fact that little definite research has been conducted concerning social aspects of agency. The study takes an in-depth look at the interaction style of computer characters and how embodiment can alter user's perception of an agent. A taxonomy of nonverbal behavior and specifically of trusting aspects of nonverbal behavior is developed from which design guidelines can be extracted to enhance the interactional style of anthropomorphic computer characters.

2. NONVERBAL BEHAVIORS

Several researchers have looked at human-human interactions and studied what kind of strategy evokes a credible response. One commonly accepted method of depicting a credible appearance in human-human interaction, evocatively supported in the literature, is that of nonverbal behavior [4][5][6][7][8]. While many have attempted to define and characterize nonverbal behavior, Ekman's approach [9], which looked at functions that nonverbal behavior support, may be the most appropriate to interactive design. More specifically, his work culminated in the definition of distinct functional areas, including emblems (i.e., nonverbal behaviors that have a direct verbal equivalent – a wave meaning 'goodbye'), illustrators (i.e., nonverbal behaviors tied to speech patterns, portraying something analogically about what is being said - an hourglass gesture to indicate a shapely woman), affect displays (i.e., nonverbal behaviors that display certain aspects of a referent's emotional and psychological state - a frown), regulators (i.e., nonverbal behaviors that maintain the back-and-forth rhythm of a conversation - eye contact or body lean to indicate wanting to take a turn in a conversation), and adaptors (i.e., nonverbal behaviors that provide information about an individual's attitude, anxiety level and self confidence - grooming of unruly hair). Ekman's categorization of nonverbal functionality is important because it not only provides an operative description of the individual roles that nonverbal cues play but also includes an integrated control spectrum leading from emblems to adaptors. Emblems are highly intentional with the referent having total control of whether they wish to reveal the behavior or not. Adaptors, on the other hand, are revealed unconsciously, affording the referent no restraint whatsoever.

Selecting the correct elements of nonverbal behavior to portray a credible façade is nontrivial. As De Meuse [10] (p. 207) states "in general, there is a lack of a cogent taxonomy of nonverbal cues" from which to choose from. De Meuse suggests a taxonomy based upon how a perceiver receives nonverbal cues, specifically in the field of performance appraisals. His overlying architecture is used here as the foundation for a generalized taxonomy of nonverbal cues. According to De Meuse's taxonomy, nonverbal cues can be broken up into those actions that are behavioral in nature and those that are not. An example of a non-behavioral cue would be ethnicity – regardless of behavior the cue remains the same. A facial gesture on the other hand would be considered behavioral as it changes based on the behavior of the individual.

A second dimension in this taxonomy describes the amount of control an individual has over the cue in question. It can be argued that certain nonverbal cues, such as age or gender, are transferred automatically, with no control possible. In contrast, other cues can be finely tuned and controlled (e.g. attire) to present a particular message or meaning. Within this framework, three regions are presented. Demographic variables are those nonverbal cues that are not under an individual's control nor behavioral in origin. They have widely understood and socially shared meanings, for example racial and ethnic stereotypes [11], age [12] and gender [13].

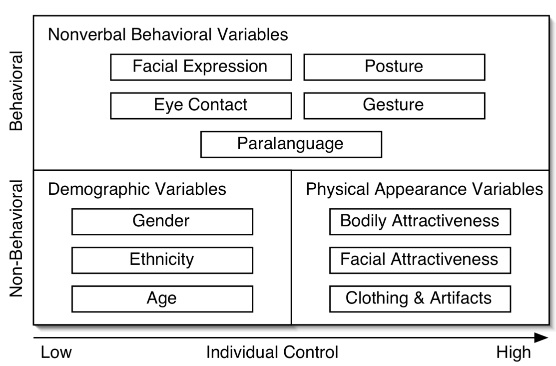

Figure 1: A taxonomy of nonverbal behavior (adapted from De Meuse, 1987)

Physical appearance cues are non-behavioral in nature and are subject to rapid change. Cues such as cosmetics, hair color, and attire can all affect someone's perceived attractiveness. The third category in De Meuse's taxonomy is non-verbal behaviors, and takes up the entire range of individual control from low (certain facial expressions such as shock) to high (smiling, nodding of head). Figure 1 depicts this framework. This current paper focuses on these nonverbal behavioral variables, including facial expression, eye contact, gestures, paralanguage, and posture. A discussion of the demographic variables [14] and the physical appearance variables [15] can be found elsewhere.

2.1. Facial Expression

Knapp [7] sees the face as the primary site for communication of emotional states and hence the primary signaling system for communication of such states. Mehrabian [16] quantified these statements when he declared that facial expression provides 55% of the meaning of a message. Facial expressions can be classified in many different ways [17]. An operationally useful classification scheme was put forth by Ekman *et al* [18], who categorized the different facial expressions into seven major messages, or emotions, namely happiness, surprise, sadness, fear, anger, disgust and interest. While some of these may be useful in the portrayal of credibility (e.g. happiness, surprise, interest) due to their encouragement of dialogue, others should perhaps be avoided (e.g. anger and disgust) [8].

Researchers have indicated that certain facial areas reveal emotional states better than others [19]. The smile is perhaps the most important facial characteristic when expressing credibility. Bugental [20] found that appropriate smiles enhance credibility and that impression was affected by the onset and offset times of smiles. Specifically, when the onset (from a neutral mouth position to a smile) and offset (from a smile to a neutral mouth position) times leading to and from the apex of the smile were increased, the referent was seen as being more credible (onset times were increased from 0.77 seconds to 0.93 seconds, and offset times were increased from 1.63 seconds to 2.39 seconds). These values could potentially be used by agent designers to specify the amount of time taken through the smile process.

In addition, when trying to express credibility and approachability, the computer character should utilize any opportunity to display brow-raised and smiling articulation while minimizing (or avoiding completely) non-smiling, lowered brow expressions [21]. Massaro [22] also emphasized the importance of miscellaneous movements such as eye blinking (Clayman [23] suggests in 5-20 per second range), eyebrow movement and slight movements of the head, during a conversation.

2.2 Eye Contact

Eye contact is a direct and powerful form of non-verbal communication [8]. In general, eye behaviors are multifunctional, serving many important functions during communication. Leathers describes several of these functions including the indication of interest, persuasion, regulation of interaction, communication of emotion and definition of social relationships such as power and status. Eye gaze can also serve as a feedback mechanism [24] or source of channel control [25].

Janik *et al* [26] found the eyes to be the region people look at most when conversing. During a dialog they found attention focused on the eyes 43.4% of the time, with the mouth being the next most frequent at 12.6%. When making eye contact, Leathers [8] stated that the direct stare of the sender of a message conveys candor and openness, a feeling of trust. He found downward glances to be generally associated with modesty, while eyes rolled upward were associated with fatigue. Webbink [27], however, found that direct stares could cause the recipient to feel challenged. Kleinke [28] found that looking down, just before a response can make the referent appear untrusting and devious. These examples confirm that any eye behavior exhibited by the character is susceptible to multiple interpretations based upon the context of the conversation.

2.3 Paralanguage

The sounds that an individual makes as they speak and the way they pronounce words all add crucial information to the message being communicated. Such vocalic information can be used to infer emotional state and personality characteristics. They can also be used to provide information on gender, age, and race [29] and functionally, in conjunction with eye contact, to indicate turn taking. Leathers [8] indicates three main functions of vocalic communication: expression of emotion (e.g., Mehrabian [30] found 38% of the emotion in a message could be attributed to vocal cues, while a study by Fairbanks and Pronovost [31] found that all emotions could be conveyed accurately by vocalic cues), regularity function (Cappella [32] found the most important vocal cues in regulating interaction are pause duration, utterance length, response latency, and intensity – with the louder individual often dominating [33]), and impression management (Zuckerman, Hodgins and Miyake [33] suggest that vocal cues may have a greater impact on interpersonal impression than even physical attractiveness, they put forth the concept of an ‘attractive voice,’ defined as sounding more articulate, non-monotonic, lower in pitch, higher in pitch range and appropriately loud; Addington [34] found that pitch and rate were the most important cues that determine personality characteristics, with those using greater variation in pitch and rate being perceived as dynamic and likable; Hosman [35] found that the speech of powerful individuals is free from hesitations and hedges, a familiar trait of submissive individuals and those of little power). Taken together, these studies indicate that vocal cues are important in an agent-human dialogue, that vocal cues, in association with facial gestures, can be used to portray very powerful emotion expressions to support an agent’s dialogue with users and hence add to the portrayal of credibility, and that agents should exercise a wide variation in pitch and rate to avoid appearing monotonic and uninteresting (a commonly expressed disadvantage of computer synthesized speech [36]) and thus encourage dialogue. In addition, agents should be endowed with an ‘attractive voice’ to portray attributes such as competence and honesty, characteristics commonly associated with credibility.

2.4 Gestures

After facial expression, gestures are the next most visible and expressive part of the human body, although they do not command as much scrutiny during interaction [8]. Unlike facial expression, there is no current categorization for hand positions and movements. The role gestures play differs from that of facial expressions in that they function as illustrators [17], augmenting verbal skills when speakers find them inadequate to express what they want to say. In many cases gestures resemble what is being discussed (for example, hands held a certain distance apart to indicate the length of an it. In such cases, it is important that gestures match verbal messages. Mismatched multi-channel messages may be perceived as deceitful [30]. Ekman and Friesen [18] found that gestures may indicate the emotional state of a person – for example, a student may exhibit their nervousness before an examination by clasping their hands together or by fidgeting with objects. In the same study they found that holding the hands and elbows close to the body was perceived as too formal in regular interaction and may portray the look of being rigid and inflexible. Such actions could potentially harm the perceived credibility of an individual if this formal appearance was out of place within a given context. In addition, Exline [37] found that gestures that appear rehearsed conveyed similar unflattering attributes.

2.5 Posture

Posture refers to the location or bearing of the body [8]. An individual’s posture has been said to convey presence [38] and be an efficient communicator of emotion [8]. Kyle [39] categorizes different postures as being either open or closed. An open posture, like leaning forward towards another individual during a conversation, indicates an open and willing attitude. A closed posture, for example sitting with arms crossed, indicates a resistive attitude. Delta [40] indicates that an open posture shows audience members that an individual is open to them and what they have to say, whereas a closed posture indicates disinterest and a general apathetic attitude. It may be important for an agent to assume mainly open postures when interacting with a user and minimize the number of closed postures to encourage dialogue and trusting behavior while limiting injurious expression. Confidence is often exhibited by steeple fingers and good upright body posture, for example square shoulders and a straight back [41]. Facing an audience squarely and upright gives the message that an individual is available and wants to interact [40]. Hands on hips can also portray confidence, as can sitting with hands clasped behind head, but both may be seen as too casual in certain circumstances [8]. An individual’s posture may also express interest, for example, sitting on the edge of a chair, with the upper body leaning forward in a sprinter position, head tilted towards the speaker. Closed postures may signal a deceitful or dishonest disposition. Arms crossed high on the chest or having legs crossed both indicate a defensive pose, shielding the body from discussion [41]. Constant fidgeting, with hands or objects, and an unusually rigid body posture, can express anxiety, insecurity and nervousness that may damage a credible façade [39]. A posture that is slouched over, shoulders hunched, with head bent down sends a signal of being nervous and uninterested in the audience [38]. Hands in pockets can lead to such a slouched stance and also appear unprofessional [40]. Finally, the hand (or any object) covering the mouth while speaking may indicate deception or dishonesty [40].

Based on this review of behavioral nonverbal cues, a set of design guidelines for computer characters was derived (see Figure 2). While each of these behavioral nonverbal elements (i.e. facial expression, eye contact, paralanguage, posture, and gesture) may be tuned to induce the perception of credibility, some may carry more weight than others. While no formal rank system was found, one can be suggested based upon the literature.

FACIAL EXPRESSION

- Use smiles sincerely when appropriate
- Use extended onset and offset times for smiles
- Use animated facial expressions (e.g. head movements)
- Avoid the use of a single neutral expression
- Maximize use of brow-raised, smiling cues
- Minimize non-smiling, lowered brow expressions

EYE CONTACT

- Maintain eye contact with the user
- Ensure eye contact is direct but not continuous
- Ensure eye contact is controlled and deliberate
- Reduce excessive blinking or eye flutter
- Avoid looking down or away, especially just before a response
- Avoid swift eye movements

PARALANGUAGE

- Use a moderately fast rate of speaking
- Avoid long pauses
- Use slight variations in pitch, rate and volume
- Avoid the use of a flat, nasal or tense voice
- Avoid 'non-fluences' (e.g. repeated words, stuttering)

GESTURES

- Ensure gestures appear spontaneous, unrehearsed and relaxed
- Match gestures to the verbal message
- Keep hands and elbows away from the body
- Avoid defensive and nervous gestures (e.g. fidgeting)

POSTURE

- Advocate open postures (e.g. upright stance, square shoulders straight back) and express interest by learning towards the user with head tilted forward
- Suppress closed postures (slouched, rigid, legs and arms crossed) and avoid obstructing the mouth when speaking

Figure 2: Design suggestions for anthropomorphic computer characters

As described previously, the face is the primary source of information in interpersonal communication. Mehrabian [16] suggested facial expression provides 55% of the meaning of a message. Janik et al [26] found attention focused on the eyes 43.4% of the time and the mouth 12.6% (the next most frequent) during a conversation. Specifically, these elements within the face (eyes and mouth) that are the areas looked at most frequently during interaction [26], are crucial in maintaining a successful conversation. Paralanguage, while not being a visual element within these facial bounds, does emanate from the facial area during a vocal exchange and should be afforded a similar level of importance. For these reasons, facial expression, eye contact, and paralanguage may be the most important elements available to a computer character wishing to utilize its embodiment to enhance credible expression and were herein considered 'primary' behaviors. According to Leathers [8] these behaviors should be used when attempting to decode what message is being sent, while the remaining behaviors (i.e. gesture and posture) should be used to describe the intensity of the message. Gestures are also an important cue, but as conversations are usually directed at face-to-face exchanges, they were herein considered a 'secondary' behavior. In a similar fashion, posture is not central to the focus of a conversational exchange, and thus posture was also considered secondary. In order to validate the guidelines proposed in Figure 2, an empirical study was conducted.

3. EMPIRICAL STUDY

Forty-eight female participants took part in a between-subjects empirical study. This number was filtered from fifty-two original participants using the Facial Meaning Sensitivity Test (a measure of the participants' ability to decode facial expressions – participants who were considered to have low facial meaning sensitivity were filtered) and the Computer Opinion Survey (a measure of the participants' Computer Anxiety Index – those participants that were too at ease with computers (and hence considered expert computer users) were filtered). Based upon the taxonomy and associated design guidelines described above, a prototype were constructed that allowed participants to interact with a computer character that would help sort their own personal photographs (see Figure 3). Based on image content, the character would attempt to sort the participants' photographs while interacting with the user. The type of nonverbal behavior expressed by the ECA was the independent variable. Depending on which of the four groups the participant was assigned to, the character would either express no nonverbal behavior whatsoever (apart from moving the lips to maintain the illusion of talking), express trustworthy facial nonverbal behavior (including primary behaviors, i.e., facial expression, eye contact, and paralanguage), express both trusting facial and bodily nonverbal behavior (both primary and secondary behaviors, the latter including gesture and posture) or express non-trusting facial and bodily nonverbal behavior (created by reversing the suggestions from the taxonomy). Results from a pretest [14][15] indicated that the character embodiment should be youthful and match the ethnicity of each participant, with character gender being left to choice. The dependent variables included both subjective and objective measures. The subjective measures included four questionnaire-style surveys. The Agent Trust Survey (based upon Rempel and Holmes Trust Scale, reworded to make it application to computer characters [42]) was used to interpret the level of trust and credibility the participants felt they had in their computer character. A Mental Workload questionnaire (adapted from Cooper-Harper's Measure of Perceived Mental Workload scale [43]) was administered to ascertain how the participant viewed the complexity of the task, An Interpersonal Trust Survey (based upon the Behavioral Model of Interpersonal Trust [44]) measured the respondents propensity to trust and to build trust. Finally, the Application Opinion Survey (adapted from a questionnaire used by Isbister [45]) attempted to obtain the participants opinion on a range of computer character properties (e.g. how they felt during the interaction, how well certain adjectives suited the character, etc).

The participants were also encouraged to speak their mind as they interacted with the prototype. The object measures included numerous human performance metrics including ‘time to complete a task’, ‘time spent recovering from errors’, etc.

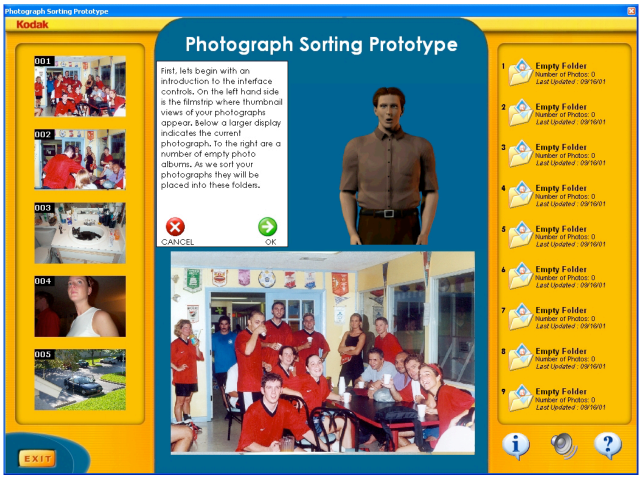

Figure 3: The experimental prototype

4. RESULTS

The main response for this study was the participants score on the Agent Trust Survey. This response was a subjective measure of the amount of trust and credibility that the participant placed in the agent after their interaction. A Kruskal-Wallis test was performed and indicated there were significant within-treatment differences (P<0.001). To determine which of the treatments differed from each other, one method would have been to use several applications of the Mann-Whitney procedure to test for significant differences between pairs of treatments. However, by doing this the probability of rejecting a true null hypothesis would be increased, in line with the number of extra comparisons made [46]. Instead, a multiple-comparison procedure, first suggested by Dunn [47] was used. This method incorporates an adjustment, called the experiment-wise error rate, which protects against error when the null hypothesis is true. As discussed in [46], the value of □ is usually set higher than when used in regular single-comparison inference procedures. Following [46], the value of □ was set at 0.15.

On applying this procedure, four of the six comparisons were found to be significant. A rank difference of -16.54 indicated that participants in the facial nonverbal behavior treatment perceived their character to be significantly more trusting and credible than those participants that interacted with the no nonverbal behavior character. All three comparisons involving the character expressing non-trusting nonverbal behavior were significant suggesting that participants interacting with a character expressing no, facial and bodily nonverbal behavior all perceived their character to be more trustworthy than the non-trusting treatment.

In comparing the treatment against perceived workload three significant comparisons were identified. By comparing the perceived workload for the non-trusting treatment against the other three treatments, in each case the non-trusting treatment was perceived as being more taxing. To investigate the differences between the treatments and the workload that the participants *expected* to face while interacting with the computer character, another Kruskal-Wallis test was performed. There were no significant (P=0.591) differences among the treatment conditions in the level of workload they would expect to have to encounter while working with the computer character. This is as should be expected, as there is no reason to believe the different treatment groups should vary in the workload level they would anticipate from such an interactive experiment. This lack of difference lends validity to the significant differences that were found in the perceived workload engendered by the non-trusting character.

Once again, a Kruskal-Wallis test was performed to investigate the differences between the treatments and the number of errors made by the participants. This indicated that there were significant (P=0.026) differences between the groups. Significant differences were found between the non-trusting treatment and both the facial and bodily treatments. The negative rank differences indicate that the participants in the non-trusting nonverbal behavior group made more errors than those participants in both the facial and bodily nonverbal behavior group respectively. In addition to these tests, protocol analysis was also used to record comments made by the participants as they interacted with the prototype. A Kruskal-Wallis test indicated that there were significant (P<0.001) differences between the comments made between the groups. The analysis suggests that those participants that interacted with the character expressing non-trusting nonverbal behaviors made significantly more negative comments than those in the facial and bodily groups.

Further analysis was performed based upon the multiple factors and responses recorded. To investigate the differences between the participants’ propensity to trust and their score on the Agent Trust Survey, a Kruskal-Wallis test was performed. The test statistic had a p-value of 0.022, both unadjusted and adjusted for ties, indicating that there was at least one difference among the treatment groups. Dunn’s method of multiple comparisons was used to determine which treatments differed significantly from each other. The results suggest that those participants with a low propensity to trust perceived their characters, irrespective of treatment condition, to be less credible than those participants with a medium or high propensity to trust.

To investigate if there was a significant difference between the expected and perceived workload, a series of Mann-Whitney tests were performed, one per treatment pair. For the no nonverbal behavior group, there was no significant difference between the perceived and expected workload (P=0.734). Similarly, for the facial and bodily nonverbal behavior groups, there were no significant differences (P=0.651 and P=0.926 respectively). The non-trusting nonverbal behavior group did produce a significant difference (P=0.003). Participants who interacted with the non-trusting character found their interaction to be significantly more demanding than they expected.

A principal component analysis was used to reduce the Application Opinion Survey elements to eight underlying factors that contributed to user-agent interaction. Three indices assessed participants' feelings about their interaction with the computer character (Eigenvalues of 6.75, 1.10 and 0.90 respectively, accounting for 79.6% of the variation). 'Positive Interaction' comprised an index of six items: 'enjoyable', 'rewarding', 'fun', 'useful', 'satisfying' and 'pleasant'. 'Interaction Difficulty' comprised an index of 1 item: 'difficult'. 'Interaction Monotony' was comprised of two items: 'tedious' and 'time consuming'. Three indices assessed participants' feelings specifically about the computer character itself (Eigenvalues of 8.93, 1.63 and 1.39 respectively, accounting for 90.5% of the variation). 'Character Affability' comprised an index of three items: 'friendly', 'helpful' and 'likable'. 'Character Accuracy' comprised an index of two items: 'fair' and 'accurate'. 'Character Aptitude' comprised of one item: 'intelligence'. Two indices assessed the participant's feeling about themselves while they interacted with the character (Eigenvalues of 5.07 and 1.26 respectively, accounting for 57.6% of the variation). 'Positive Feelings' comprised an index of three items: 'happy', 'pleasant' and 'friendly'. 'Power Feelings' comprised an index of two items: 'powerful' and 'important'.

Nonparametric analysis (Kruskal-Wallis) found there to be significant group differences ($P<0.01$) in all but one of the indices. 'Interaction Difficulty' was not significant ($P=0.4$) in respect to the treatment groups. For those seven indices that were different, Dunn's multiple comparisons procedure was used to indicate how the treatments differed in respect to each other. The non-trusting character was found to engender significantly less positive interaction and significantly more interaction monotony than the other treatments. In terms of character traits, the non-trusting character was found to be significantly less likable, significantly less accurate and significantly less intelligent than characters from the other treatments. Finally, participants that interacted with the non-trusting character rated themselves as being significantly more positive and powerful than those participants that interacted with the other characters.

Summarizing these statements, results indicated that participants that interacted with computer characters endowed with primary trusting behaviors perceived them as being more trustworthy and satisfying to interact with than those who interacted with a character with no nonverbal behaviors. There were no significant differences between the two levels of nonverbal behaviors, suggesting that little may be gained by the addition of secondary behaviors (i.e., bodily gestures and posture) to anthropomorphic computer agents already using facial nonverbal behavior. The character that expressed non-trusting nonverbal behaviors was perceived to be the least credible of all the characters; participants that interacted with this character found the experience to be quite frustrating and dissatisfying. Participants that interacted with the non-trusting persona perceived the task to be more demanding, made significantly more errors and rated their interaction less positively and more monotonous than those interacting with trusting personas. They also rated their character to be less likable, accurate and intelligent.

5. DISCUSSION

In brief, this study demonstrated that by incorporating trusting nonverbal behavior into the interaction strategy of a computer character, the perception of that character's credibility and trustworthiness could be increased. Specifically, trusting facial nonverbal behavior (i.e. facial expression, eye contact, and paralanguage) was found to encourage a trustworthy relationship between participant and character. The addition of trusting bodily nonverbal behavior (i.e. posture and gesture) did not increase the perceived level of credibility. This may have been due to the power of the empirical design, or the fact that the embodied gestures and posture movements did not appear realistic enough. In addition, a task that demands more active use of gestures may potentially have produced different results. Nonetheless, based on the results of this study, the use of trusting bodily nonverbal behaviors cannot be recommended. This suggests interface layout designs that use agent embodiments should perhaps use close up views of a character's face in place of the full body view.

Perhaps as important as ensuring trusting nonverbal behaviors are portrayed is to make certain that non-trusting behaviors are avoided. When a character is behaving in a non-trusting manner, participants may make more mistakes, find the task more demanding, and fail to enjoy the interaction. This has wide ranging implications for interaction designers that do not consider the impressions that certain behaviors may depict. While trying to make their characters more alive and interesting, they may in reality be emanating nonverbal messages that are negatively perceived by users.

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