MAKING FACES: EXPLORING PERCEPTIONS OF PERSONALITY BASED ON EMOTIONAL EXPRESSIONS

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Researchers at Wright State University have been working on modeling computer agents with personality. Perception of personality between humans is based on many factors, one of which includes facial expression. Many researchers have explored the ability to recognize emotion in faces, while other research focuses on perception of personality based on faces (physiognomy). The purpose of this study combines these two areas of research to determine how participant's rate different personality dimensions based on emotional expression. Participants rated ten static computer faces on the 30 personality subtraits from the Big Five Factor model of personality. The results show that participants did rate personalities differently depending on the facial expression. Participants perceived similar personality traits between the two different faces that expressed the same emotion. Results will be discussed along with future research directions.

INTRODUCTION

The growing size and complexity of computer systems is spawning the use of "smart" computer agents that serve the needs of human operators. These smart computer agents are designed to reduce the cognitive workload of human operators by hiding or fading less critical information, providing data summary, highlighting important information (bigger, brighter, flashing, etc), or taking control of some tasks. However, as these complex systems continue to expand, it becomes increasingly important to create methods to further improve human-machine collaboration. One way to improve this interaction may be to create computer agents with personality. Computer agents with personality may enhance human-machine collaboration because the interaction becomes a collaborative partnership, able to better augment human capabilities by addressing the cognitive and social aspects similar to human-human collaboration.

Researchers have acknowledged the need to develop computer agents that act and react more like humans to provide a naturalistic human-machine interaction, as well as provide more realistic models of virtual humans (Pew and Mavor, 1998; Silverman, et. al., 2003; Wray and Laird, 2003). Prabhala and Gallimore (2005) have been working to develop computer agents with personality. They investigated actions, language, and/or behaviors that humans say lead to their impressions of personality within the Big Five Factor personality trait model. They have developed a discrete simulation in which the computer agent interacts with the user via multimodal output, providing tactile, visual and auditory interaction to express personality. In the initial phase of their research, facial information is excluded to avoid the perception of personality based on stereotypes. Recognizing that non-verbal facial communication also affects perception of personality, future phases of their research will attempt to incorporate facial features.

The study of how people project and perceive emotion through facial expressions has been and continues to be intensely examined. Research shows that humans are universally and cross culturally proficient at expressing and interpreting five primary emotions: anger, fear, joy, sadness and disgust (Ekman, Sorenson and Frieson, 1969). Emotions such as surprise and shame can be proficiently expressed and interpreted; however, Izard (1971) concluded that head position is more revealing than facial expression. Inconclusive results on evaluating other emotions are attributed to an individual's inability to accurately project complex emotions and further confounded by an inability to reliably interpret the intended emotion (Ekman, 1978). Additionally, individual interpretation of expressions is dependant on the mood of the observer (Ruckmick, 1921) and the intensity of the expression. Recent biological and neurological studies of emotion have shown that there is a relationship between facial expression and autonomic measures of arousal (Hagar and Ekman, 1983) supporting earlier ideas that many facial expressions are innate and not visually learned (Charlesworth and Kreutzer, 1973). This supports conclusions on the universal nature of the five primary facial expressions.

Physiognomy is the art of reading personality traits from the characteristics of static faces. Hassin and Thrope (2000) observed that physiognomy plays a significant roll in how humans interpret information. They hypothesize that "physiognomy is an integral part of social cognition." They refer to this as the effect of "reading from and into faces." The conclusions they draw from a series of six studies are: physiognomic information changes people's impression of information, where ambiguous information is interpreted with more reliance on facial impression.

Research shows that people can and do read both emotion and personality from other peoples' faces. This observation opens the possibility of designing computer agents with facial characteristics that project an assigned

personality. The objective of this research was to determine how subjects perceive personality in static digital faces based on different emotional expressions. This research is a first step toward the longer term goal of combining facial expression with other interactions for the development of computer agents with personality.

METHOD

Subjects

Fifty-eight students from a major mid-west university volunteered to serve as participants. Most participants were between the ages of 20 and 30. Nationality was unevenly distributed with 48 American and 10 Indian participants, with gender more evenly distributed between 30 males and 28 females. The participants were randomly blocked in the following groups: Face set A (27) and Face set B (31).

Stimuli

Two sets of digital faces (A and B) consisting of five faces each (10 faces total) were used as stimuli to measure human perception of faces in terms of personality traits. Each set of five faces included five emotional expressions: anger, fear, joy, sadness and neutral.

The first set of faces (A) was borrowed from the research of Goren and Wilson (2006). They generated digital faces using an averaging and filtering procedure. Facial measurements from 37 individuals were averaged into a single face which was then bandpass filtered. The result is the neutral face shown in Figure 1, A5. They digitally manipulated this neutral face into the four expressions, shown in Figure 1, A1-A4.

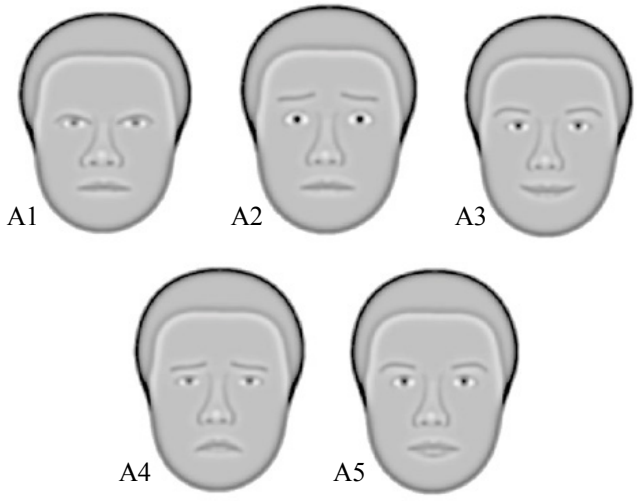

Figure 1: Face Set A; A1-anger, A2-fear, A3-joy, A4-sadness, and A5-Neutral (Goren and Wilson, 2006)

The second set of faces (B) was generated using FaceGen Modeller 3.1 software (Figure 2). The faces were generated by making minor adjustments to the 'average face' for a 30 year old male with 50% European 'race morphing.'

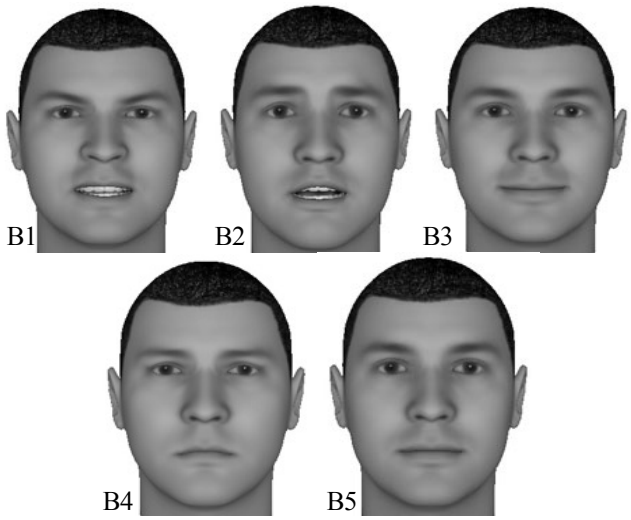

Figure 2: Face Set B; B1-anger, B2-fear, B3-joy, B4-sadness, and B5-Neutral (presented in color during data collection)

Procedure

Using a web based survey, participants were asked to rate each face on the 30 subtrait dimensions of The Big Five Factor personality trait model (Goldberg, 1990). This model has five independent dimensions or factors also known as central traits that account for much of the variation in personality. They are: I. Extraversion, II. Agreeableness, III. Conscientiousness, IV. Emotional Stability vs. Neuroticism, and V. Intellect or Openness. Each central trait is subdivided into six subtraits or facets that describe the central trait, for a total of 30 subtraits. Subjects were given a description of each subtrait and were then asked to rate the five faces for all 30 subtraits using a five point Likert scale (1 = not characteristic, 3 = partially characteristic, 5 = fully characteristic). These ratings represent the dependent variable for this study. The independent variables included subject Gender, Face Set (A and B), Expression (Anger, Joy, Fear, Sad, and Neutral) and Personality Trait (5 Factors).

The faces and questionnaire were presented via the web using us Qualtrics.com online survey software. To limit the length of the survey each participant rated only one set of five faces (A or B). The 30 subtraits were randomly divided into three groups to reduce the number of items per screen and to allow the face and all items to be simultaneously visible without scrolling. The order of the faces, the order of the three groups of subtraits and the order of the subtraits on each page were randomized to minimize order effects.

RESULTS

To conduct the analysis subtrait ratings for each of the five central personality traits identified in the Big-Five Factor personality model were averaged to determine a mean rating for each central personality trait. This is consistent with the way subtrait scores are averaged into personality traits for the Big-Five Factor personality model. A full factorial mixed-design ANOVA (Gender * Face Set * Expression * Personality Trait) was conducted to analyze the results. The results, shown in Table 1, indicate several significant interactions and main effects.

Source	DF	SS	MS	F Ratio	Prob > F
Gender	1	94.782	94.782	3.053	0.086
FaceSet	1	127.027	127.027	4.092	0.048
Expression	4	560.943	140.236	40.983	<.0001
Personality Trait	4	118.862	29.715	11.022	<.0001
Gender*FaceSet	1	19.991	19.991	0.644	0.426
Gender*Expression	4	42.870	10.717	3.132	0.016
Gender*Personality Trait	4	8.993	2.248	0.834	0.505
FaceSet*Expression	4	16.690	4.172	1.219	0.304
FaceSet*Personality Trait	4	71.135	17.784	6.596	<.0001
Expression*Personality Trait	16	1578.780	98.674	59.830	<.0001
Gender*FaceSet*Expression	4	23.167	5.792	1.693	0.153
Gender*FaceSet*Personality Trait	4	3.607	0.902	0.335	0.855
Gender*Expression*Personality Trait	16	55.878	3.492	2.118	0.006
FaceSet*Expression*Personality Trait	16	99.068	6.192	3.754	<.0001
Gender*FaceSet*Expression*Personality Trait	16	26.640	1.665	1.010	0.444
Error	1350				

Table 1: ANOVA summary of subject's ratings when rating the face for personality trait

Looking first at the primary focus of this study, the different emotional expressions did result in different ratings for the different personality traits. In essence this produced a perceived personality profile based on the expression of a face as visualized in Figure 3. The significant interactions among Face Set x Expression x Personality Trait ($F(16, 864) = 3.7543$, $p \leq 0.0001$) and Expression x Personality Trait ($F(16, 864) = 58.8299$, $p \leq 0.0001$) both support the idea that perceived personality is related to the emotional expression of a static digital face.

A simple-effects F-test by expression for the three-way interaction of Face Set x Expression x Personality Trait (see Figure 3) reveals that in most cases the two sets of faces did not receive significantly different ratings. In all cases where the face sets received significantly different ratings, face set B was rated higher than face set A. In general two faces with the same expression received similar ratings with the face from set B rated slightly higher.

A hierarchical cluster analysis was also performed to see whether participants were able to perceive the same personality traits for faces (A and B) with the same emotional expression. Results indicated that participants perceived similar personality traits between faces (A1, B1) anger, (A3, B3) joy, and (A5, B5) neutral. That is participants perceived personality traits in face (A1) the same as those of face (B1) and similarly for faces (A3, B3) and faces (A5, B5). Participants' perception of personality traits in face set (A2, fear) were similar to face set (A4, sadness) and those of face set (B2, fear) were similar to face set (B4, sadness). This can be attributed to the fact that there exists strong correlation between facial expressions fear (A2, B2) and sad (A4, B4). Examining Figure 2 it is evident that these facial representations lack clarity as both the expressions have raised eyebrows and lips bent down, which could confuse the participants.

Examining Figure 3 several interesting relationships are visible. For the expression joy, participant average ratings were at or above 3 (partially characteristic) for the personality traits of extroversion, agreeableness, contentiousness and openness, while neuroticism was rated closer to not characteristic (1.5). This profile suggests that a joyful expression is likely to be perceived as being extroverted, agreeable, contentious and open, without being neurotic.

For the neutral expression the personality profile was similar to the joyful expression in that neuroticism was rated significantly lower than the other traits. The main difference is that the neutral expression has generally lower ratings.

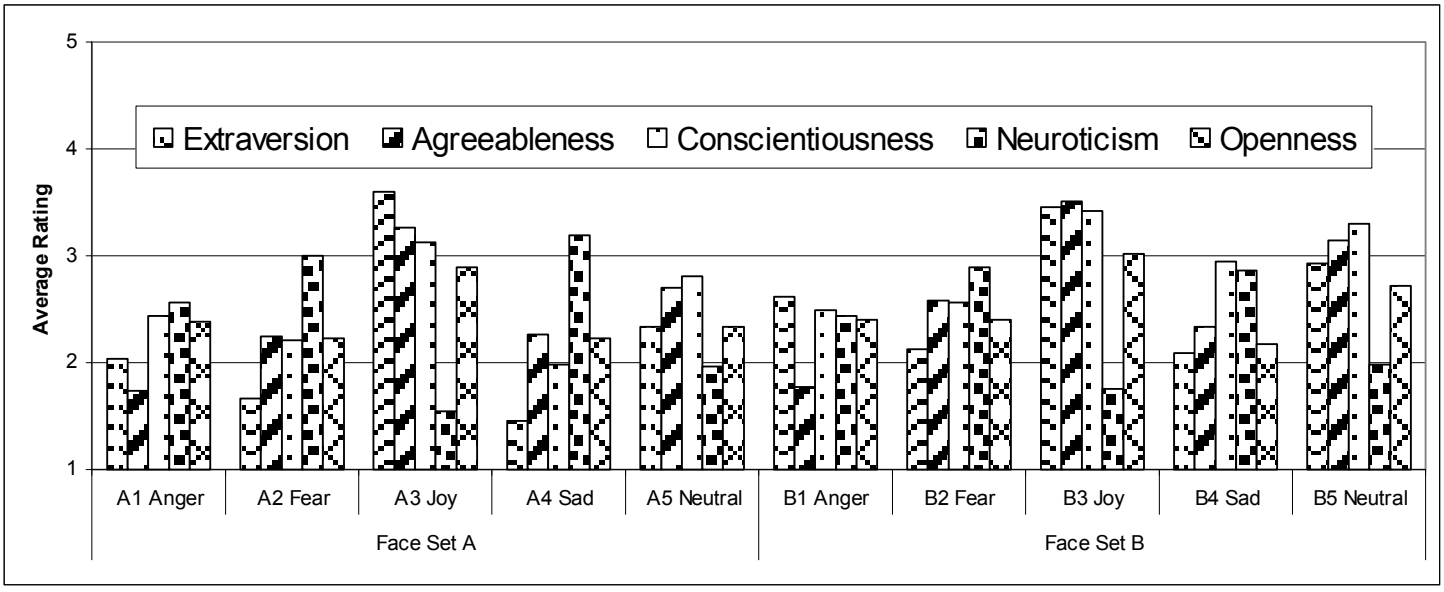

Figure 3: *Average Rating for Personality Trait by Face Set and Expression*

For the expression anger, average ratings for all traits were lower, at 2.5 or below with the personality trait of agreeableness rated even lower at 1.75. This profile indicates that an angry expression is likely to be perceived as being disagreeable at the same time exhibiting low scores in the other four personality traits.

For the expressions sad and fear the average ratings for neuroticism were near 3 and significantly higher than the ratings for any of the other traits. These expressions also have significantly lower ratings for extroversion. These average ratings imply that sad and fearful expressions may be perceived as being both introverted and neurotic.

DISCUSSION

This study was conducted to measure participant's perceptions of personality based only on facial expression of digitally generated faces. The results show that participants do rate personalities differently depending on the facial expression presented. Hassin and Thrope (2000) point out that evidence suggests that people can and do infer personality traits from other's faces and that different people reliably infer the same personality traits from given faces, including cross culturally. Although these judgments are consistent, the validity of these judgments is questionable. An individual's confidence in their physiognomic judgments far exceeds the accuracy of those interpretations (Hassin and Thrope, 2000). They also state that physiognomic information is incorporated into decision making, even when people are asked to intentionally ignore people's faces.

In the quest to develop collaborative computer agents with personality, any consistency of user perception could allow designers to reliably select an agent's personality. It is important to consider facial expression in combination with other forms of communication to provide appropriate impressions of personality. Interestingly, the results of this study showed that the personality traits assigned to a joyful expression matched the traits subjects identified as ideal for a collaborative partner in the study conducted by Prabhala and Gallimore (2005). The next phase of this research will investigate perception of personalities based on facial expression when a computer agent makes suggestions as a team member on a collaborative task. We also plan to move forward to incorporating faces with the other non-verbal and verbal communications into the current multimodal simulation platform. Developing computer agents that have human characteristics may improve human computer interaction, collaboration and increase user trust in complex systems. This research is a first step in determining how facial expression could be incorporated in the design of computer agents to provide distinct impressions of personality.

REFERENCES

Charlesworth, W.R., and Kreutzer, M.A. (1973). Facial expression of infants and children. *Darwin and Facial Expression.* New York: Academic. pp. 91-168.

Ekman, P., Sorenson, E.R., and Frieson, W.V. (1969). Pan-cultural elements in facial emotion. *Science,* 164, pp. 86-88.

Ekman, P. (1978). About brows: Emotional and conversational signals. Human Ethology. Cambridge University Press.

Goldberg, L. R. (1990). An alternative "description of personality": the big five factor structure. Journal of Personality and Social Psychology, 59(6), 1216-1229.

Goren, D and Wilson, H.R. (2006). Quantifying facial expression recognition across Viewing Conditions.Vision Research, 46(8-9),1253-62.

Hagar, J.C., and Ekman, P. (1983). The Inner and outer meanings of facial expressions. Social Psychology: A Sourcebook. New York: The Guilford Press.

Hassin, R., and Thrope, Y. (2000). Facing faces: studies on the cognitive aspects of physiognomy. Journal of Personality and Social Psychology, 78(5), pp. 837-852.

Izard, C.E. (1971). The Face of Emotion. New York: Appleton-Century-Crofts.

Pew, R. W., & Mavor, A. S. (1998). Modeling human and organizational behavior: Applications to military *simulation*. Washington, D.C.: National Academy Press.

Prabhala, S., and Gallimore, J.J. (2005). Developing computer agents with personalities. *Proceedings of the 11th International Conference in Human-Computer Interaction*. Las Vegas, NV, CD-ROM publication.

Ruckmick, C.A. (1921). A preliminary study of the emotions. *Psychology Monographs,* . 30, pp. 30-36.

Silverman, B. G., Cornwell, J., and O'Brien, K. (2003). Human performance simulation. In J.W. Ness, J.W. Ritzer, and V. Tepe (Eds.). *Metrics and methods in human performance research toward individual and small unit simulation.* Washington, D.C.: Human Systems Information Analysis Center

Wray, R.E., and Laird, J.E. (2003). Variability in human behavior modeling for military simulations, *Proceedings of the 2003 Conference on Behavior Representation in Modeling and Simulation*, Scottsdale, Arizona.