Recommendations for Designing Maximally Effective and Persuasive Health Agents

Jesse Fox[1] and Sun Joo (Grace) Ahn[2]

[1] The Ohio State University, Columbus, OH, USA
fox.775@osu.edu
[2] University of Georgia, Athens, GA, USA
sjahn@uga.edu

Abstract. HCI designers have made significant advancements in the development of health agents. Although these developments are often technologically impressive, social scientific research provides some contraindications. Here, we review relevant social scientific research on tailoring, customization, agency, and realism that provides guidelines on how to design health agents and avatars to maximize persuasive outcomes in health contexts.

Keywords: Agents, avatars, health technology, virtual environments, video games.

1   Introduction

Science fiction often presents a future of synchrony and synthesis between humans and machines, wherein virtual agents and robots are unquestionably accepted as social interactants. In the current era, however, many people remain skeptical about the social role of such technologies. If people do not accept or trust agents, it does not matter how sophisticated their design is, as humans are likely to reject them, especially in a significant, personal area like health care. Social scientific research on human-computer interaction (HCI) and computer-mediated communication (CMC) provides some key insights into how we can best design health agents that people will heed.

2   Tailoring and Customization

One advantage of agents is the ability to customize them to tailor both the source and the message specifically to the user. Health scholars have long touted the advantages of using computers to tailor messages to audiences [1,2]. Recent research has also elaborated how digital technologies can allow us to manipulate the source for maximal effectiveness as well [3,4].

Agent tailoring could manifest in many ways. The visual appearance of a health agent could be tailored to what is most effective for the individual, the message, and the context [5]. The degree of threat present in the message may shift preferences in the appearance of agents [6]. Social cognitive theory also suggests that we are more

persuaded by sources that we identify with or feel similar to [1]. A growing body of research demonstrates that photorealistic virtual representations of the self (i.e., virtual doppelgängers) are effective at persuading individuals to engage in health-related behaviors [7,8,9] because users feel high levels of identification with the virtual self, driving feelings of self-efficacy [1]. Further, virtual agents can be manipulated to show the rewards or punishments associated with a health behavior [1]. These virtual selves could show virtual selves tailored to the individual's motivations.

Like other forms of tailoring, virtual health agents may encourage longer-term behavior changes. Virtual selves promoted exercise behavior up to 24 hours following treatment [7]. Augmenting traditional health pamphlets with virtual simulations to promote healthy food choices led to effects that persisted for up to one week [10]. Other studies have studied longer-term interactions for up to six weeks and have found that even small amounts of social interactions between the virtual agent and the user encourages longer-term adherence to the promoted health program [11].

3   Perceived Agency

Human users often engage in their own Turing tests. Although frameworks such as the computers as social actors approach [12] suggest that humans do not distinguish computers and humans, a recent meta-analysis found that when people perceive that they are interacting with a computer that source is less capable of influencing the user than when they believe they are interacting with a human [13].

The model of social influence in virtual environments [14] suggests perceived agency is important because it affects the degree of social presence an individual feels; entities perceived as being controlled by computers (agents) elicit less social presence than those perceived as being controlled by humans (avatars). When greater social presence is experienced, more social influence will occur because users will perceive and interact with the representation like a real person.

In health contexts, users may have negative reactions if they perceive they are interacting with a machine. Perceived caring and interpersonal warmth are among the strongest predictors of satisfaction with health care providers and adherence to prescribed treatments [15]. Although there is limited research on perceptions of agents conducted in actual health settings, research in the area of telemedicine indicates that patients strongly prefer interacting face-to-face compared to video conferencing or interactive virtual environments, which patients find "cold" [16].

When creating health agents, designers may need to reinforce humanness by enabling natural speech, nonverbal behaviors, emotions, flexibility, contingency, context consideration, and other markers of humanness [17,18]. Designers must enable humanness by avoiding highly scripted behaviors, personalizing and tailoring details of the interaction, and even affording disfluencies such as interruptions [18].

4   Realism

Blascovich's [14] model suggests that with increasing behavioral realism, the effect of perceived agency washes out. That is, the more realistic an agent behaves, the more

persuasive it becomes. Thus, the end goal for designers should be to create realistic agents that are indistinguishable from humans.

Physical realism is the degree to which something is seen, heard, or experienced as it would in the physical world. This realism is important because it influences perceptions of an agent's credibility [19]. Physical realism would include the work of animators and programmers whose goal is to develop human-like agents that have natural movements, authentic facial expressions, and even a lifelike gleam in their eyes.

Social realism is considerably more complex, and can include nonverbal and verbal behavior. Programmers developing conversational agents and artificial intelligence for interaction must incorporate not only linguistics and logic, but also interpersonal, social, and cultural appropriateness and norms. What social scientific research reveals is that although physical realism can be persuasive in virtual environments, social realism and the resulting social presence is often the more important cue in terms of influence. Indeed, users disclose more to physically unrealistic representations [20], perhaps because they feel less judged.

Designers should also be wary of "not quite real" virtual agents that descend into the uncanny valley and make users uncomfortable [21]. Although theorists expect positive reactions to lifelike entities [14, 21], until we have perfected these technologies, research indicates that near-realism may have drawbacks.

5   Conclusions

In sum, social science provides designers of health agents with some food for thought. Although these guidelines are supported by substantial research and theory, it is crucially important for designers to consider that a one size fits all approach will not work for all health contexts. The need for this information reinforces why it is necessary for HCI designers, medical practitioners, and social scientists to collaborate to optimize the development of health agents.

References

1. Bandura, A.: Health Promotion by Social Cognitive Means. Health Education & Behavior 31, 143–164 (2004)
2. Noar, S.M., Harrington, N.G.: Computer-Tailored Interventions for Improving Health Behaviors. In: Noar, S.M., Harrington, N.G. (eds.) eHealth Applications: Promising Strategies for Behavior Change, pp. 128–146. Routledge, New York (2012)
3. Ahn, S.J., Bailenson, J.N.: Self-Endorsing Versus Other-Endorsing in Virtual Environments: The Effect on Brand Preference. Journal of Advertising 40, 93–106 (2011)
4. Baylor, A.L.: Promoting Motivation with Virtual Agents and Avatars: Role of Visual Presence and Appearance. Philosophical Transactions of the Royal Society B: Biological Sciences 364, 3559–3565 (2009)
5. Fox, J.: Avatars in Health Communication Contexts. In: Noar, S.M., Harrington, N.G. (eds.) eHealth Applications: Promising Strategies for Behavior Change, pp. 96–109. Routledge, New York (2012)

6. Fox, J., Bailenson, J.N.: Manipulating Virtual Representations to Promote Sunscreen Use. Paper presented at the 97th Annual Conference of the National Communication Association, New Orleans, LA (2011)
7. Fox, J., Bailenson, J.N.: Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors. Media Psychology 12, 1–25 (2009)
8. Fox, J., Bailenson, J.N., Binney, J.: Virtual Experiences, Physical Behaviors: The Effect of Presence on Imitation of an Eating Avatar. PRESENCE: Teleoperators & Virtual Environments 18, 294–303 (2009)
9. Fox, J., Bailenson, J.N., Ricciardi, T.: Physiological Responses to Virtual Selves and Virtual Others. Journal of CyberTherapy & Rehabilitation 5, 69–72 (2010)
10. Ahn, S.J.: Incorporating Immersive Virtual Environments in Health Promotion Campaigns: A Construal-Level Theory Approach. Health Communication
11. Bickmore, T., Schulman, D., Yin, L.: Maintaining Engagement in Long-Term Interventions with Relational Agents. International Journal of Applied Artificial Intelligence 24, 648–666 (2010)
12. Fox, J., Ahn, S.J., Janssen, J., Yeykelis, L., Segovia, K.Y., Bailenson, J.N.: A Meta-Analysis Quantifying the Effects of Avatars and Agents on Social Influence. Human-Computer Interaction
13. Blascovich, J., Loomis, J., Beall, A.C., Swinth, K.R., Hoyt, C.L., Bailenson, J.N.: Immersive Virtual Environment Technology as a Methodological Tool for Social Psychology. Psychological Inquiry 13, 103–124 (2002)
14. Nass, C., Moon, Y.: Machines and Mindlessness: Social Responses to Computers. Journal of Social Issues 56, 81–103 (2000)
15. Zolnierek, K.B.H., DiMatteo, M.R.: Physician Communication and Patient Adherence to Treatment: A Meta-Analysis. Medical Care 47, 826 (2009)
16. Buck, S.: Nine Human Factors Contributing to the User Acceptance of Telemedicine Applications: A Cognitive-Emotional Approach. Journal of Telemedicine and Telecare 15, 55–58 (2009)
17. Gratch, J., Marsella, S.: Lessons From Emotion Psychology for the Design of Lifelike Characters. Applied Artificial Intelligence 19, 215–233 (2005)
18. McFarlane, D.C., Latorella, K.A.: The Scope and Importance of Human Interruption in Human-computer Interaction Design. Human-Computer Interaction 17, 1–61 (2002)
19. Nowak, K.L., Rauh, C.: The Influence of the Avatar on Online Perceptions of Anthropomorphism, Androgyny, Credibility, Homophily, and Attraction. Journal of Computer Mediated Communication 11, 153–178 (2005)
20. Bailenson, J.N., Yee, N., Merget, D., Schroeder, R.: The Effect of Behavioral Realism and Form Realism of Real-time Avatar Faces on Verbal Disclosure, Nonverbal Disclosure, Emotion Recognition, and Copresence in Dyadic Interaction. Presence 15, 359–372 (2006)
21. Mori, M.: The Uncanny Valley. Energy 7, 33–35 (1970)