Viewpoint

Common Relationship Factors in Technology-Delivered Interventions

Abstract
The use of technology-delivered interventions (often referred to as e-interventions) has risen dramatically over the past two decades. It is important to consider e-intervention research within the broader therapy outcome literature. Among other key findings, this broader literature suggests that common relationship factors, such as empathy, positive regard, and genuineness may play a critical role in therapy effectiveness. These findings raise intriguing questions for e-interventions. For example, can e-interventions incorporate aspects of common factors in order to augment their efficacy? Will the absence of relationship-based common factors make e-interventions less effective? The current viewpoint article addresses these questions, as well as related issues such as how to operationalize relationship qualities in the context of an e-intervention and whether common relationship factors apply to computers or computerized narrators. The paper concludes by outlining a future research agenda guided by theory and empirical studies.

Keywords
Mobile health, mHealth, Smartphone, Empathy, E-intervention, Common factors.
Common Relationship Factors in Technology-Delivered Interventions

Technology-delivered interventions, or e-interventions, have become increasingly prevalent both on the internet and in the scientific literature [1,2]. Currently, there are 7,811 publications using the terms “online intervention” or “e-intervention” indexed on PsychINFO, including multiple meta-analyses within sub-areas of the field [3-5]. There are also more than 100,000 iPhone and Android apps specifically designed to target health-related behaviors [2]. Researchers working in this area often cite the potential of e-interventions to reach a large audience at low cost, regardless of barriers related to language, geographic location, or time. These factors make e-interventions uniquely applicable to non-treatment-seeking individuals, who may refuse extended, in-person treatment but accept a minimal, opportunistic intervention.

It is important to consider e-intervention research within the broader, person-delivered therapy outcome literature. Among other key findings, this literature suggests that common relationship factors such as empathy, alliance, positive regard, and genuineness play a critical role in therapy effectiveness and account for unique variance in treatment efficacy above and beyond specific therapeutic techniques [6]. Specifically, ratings of therapist-client relationship factors have been shown to predict therapy outcome across rater-type (client, therapist, observer), observed relationship characteristics (empathy, genuineness, alliance, cohesion), patient characteristics (age, gender, race, diagnosis), stage of therapy (early, middle, late), and theoretical orientation [6,7].

These findings raise intriguing questions for e-interventions [1-4]. For example, will the absence of relationship-based common factors make e-interventions less effective? Can e-interventions incorporate aspects of common factors in order to augment their efficacy? Do qualities such as empathy and positive regard matter in the context of an e-intervention? The current review will address these questions as well as related issues, such as how to
operationalize relationship qualities in the context of an e-intervention. In particular, we will (1) review research suggesting that humans react to computers in social ways and respond positively to software using human-like relational agents, (2) describe studies directly testing the hypothesis that common factors increase e-intervention efficacy, and (3) outline a future research agenda guided by both comprehensive theory and empirical studies.

**Responding to Computers in Social Ways**

Literature from the field of human-computer interaction suggests that people automatically and unconsciously react to computers in social ways [8,9]. Much of the early work in this area was conducted by Nass and colleagues who, through a wide-ranging series of studies, found that human-computer interactions closely mirrored human-human interactions. For example, Nass, Moon and Carney [10] assigned participants to work with a computer on an interactive tutoring task in which the computer presented and tested participants on a series of facts. After the task, participants were asked to evaluate the computer’s performance. Participants completed the evaluation either (1) on the same computer that administered the task, (2) on a different computer in another room, or (3) on a paper and pencil questionnaire. Results showed that participants gave more positive evaluations when the computer asked about its own performance versus when participants completed the evaluation on a separate computer or on a paper and pencil questionnaire. Thus, participants appeared to apply social norms of politeness to the computer (despite denying they did this in post-experimental interviews).

In a similar study, Moon [11] examined how norms of self-disclosure were applied to computers. Participants were asked a series of interview questions by a computer (e.g. “What have you done in your life that you feel most guilty about?” “What do you dislike about your physical appearance?”). In the no-reciprocity condition, the computer simply asked each question without presenting additional information. In the reciprocity condition, the computer
preceded each question with information about itself (e.g. “There are times when this computer crashes for reasons that are not apparent to its user. It usually does this at the most inopportune time, causing great inconvenience for the user. What have you done in your life that you feel most guilty about?”). Results showed that participants in the reciprocity condition provided more and longer disclosures than participants in the no reciprocity condition. They also reported being more attracted to the computer.

Other studies suggest that humans respond positively to flattery from a computer. For example, Fogg and Nass [12] instructed participants to play a guessing game with a computer (similar to 20 questions). As part of the game, participants were asked to suggest guesses that might be useful to the computer in the future. They then received feedback about their suggestions from the computer (e.g. “Your question makes an interesting and useful distinction. Great job!”). Participants in the sincere praise condition were told that feedback from the computer was directly related to their suggestions, participants in the flattery condition were told that computerized feedback was pre-programmed and unrelated to their suggestions, and participants in the generic feedback condition were given a neutral message (“Begin next round”). In reality, all feedback was pre-programmed and identical. Results showed that participants in the flattery condition reported more positive affect and gave higher ratings to the computer than participants in the generic feedback condition, even though they were told that computer feedback was unrelated to their responses. Moreover, responses from participants in the flattery and sincere praise conditions did not differ.

Other data indicate that humans automatically apply social categories (gender, ethnicity, ingroup/outgroup) to computers. For example, Nass, Isbister and Lee [13] asked Korean male participants to read a series of hypothetical scenarios in which they had to choose between a
risky versus a safe course of action. Participants were then instructed to ask a computerized agent what course of action he would recommend and why. Afterwards, participants were asked to rate the computerized agent and the quality of his arguments. In some cases, the computerized agent was Asian (i.e. the same ethnicity as the participant), whereas in other cases, he was Caucasian (i.e. a different ethnicity than the participant). Results showed that participants rated same-ethnicity agents as being more attractive, trustworthy, persuasive, and intelligent than different ethnicity agents. Participants also felt that the same-ethnicity agent’s decision was closer to their own.

In a similar study, Nass, Fogg, and Moon [14] examined whether humans could feel in-group bias towards a computer. In this study, participants were assigned to either a shared identity condition or a non-shared identity condition. In the shared identity condition, participants and their computer were referred to as ‘the blue team.’ Participants were asked to wear a blue armband and to work with a computer that had a blue border around its monitor. Participants in this condition were reminded that they were dependent upon the computer. In the non-shared identity condition, participants wore a blue armband and were referred to as ‘the blue person,’ whereas the computer had a green border and was referred to as ‘the green computer.’ Participants in this condition were asked to focus on individual responsibility. After being assigned to an identity condition, participants worked with the computer on a desert survival problem. They then ranked their interaction with the computer along a variety of indices. Results showed that participants in the shared identity condition rated the computer as being more friendly, intelligent and similar to themselves than did participants in the non-shared identity condition. They were also more likely to cooperate with the computer and conform to its suggestions.
Finally, data suggest that humans can feel ostracized by computers. For example, Zadro, Williams and Richardson [15] instructed participants to control the actions of an avatar who was playing a game of catch with two other avatars on a computer screen. Participants were told that, when they received the ball, they should click on one of the other two avatars to indicate where the ball should go next. In the low ostracism condition, participants received the ball multiple times throughout the game. In the high ostracism condition, participants only received the ball once or twice at the beginning of the game. Data revealed that, compared to low ostracism participants, high ostracism participants experienced a host of negative feelings, including anger, and lowered feelings of belonging, self-esteem, control, and meaningfulness. Moreover, these feelings were produced even when participants (1) knew that they were playing against a computer, rather than another human and (2) were explicitly told that the other characters’ actions were determined by a pre-written script.

Notably, social reactions to computers appear to be universal, occurring regardless of age, gender, education level, or technological expertise. Additionally, these reactions seem to occur in response to both simple and complex forms of media (e.g., simple two dimensional characters versus complex virtual scenes; [16]). In sum, computers appear to elicit the same social scripts, expectations, and reactions that one would expect from a human interactant.

**Relational Agents**

Building on the work reviewed above, researchers have begun to examine the degree to which individuals can establish human-like relationships with computerized characters or “relational agents.” Relational agents are animated figures who are capable of mimicking human social interactions by using humor, engaging in small talk, expressing emotion, making empathic statements, referencing past experiences with the user (e.g. “You were feeling down yesterday”),
and meta-communicating about relationships (e.g. “How do you think our relationship is going?”) [17,18].

A growing body of literature suggests that computerized relational agents are satisfying to work with, can provide support, and can help with variety of diverse tasks [19,20]. For example, Bickmore, Utami, Matsuyama, and Paasche [21] developed an animated relational agent designed to help individuals find cancer-related clinical trials using the National Cancer Institute’s (NCI) database. Participants were 89 individuals with a cancer diagnosis and varying levels of health literacy. All participants were asked to search the NCI database for one clinical trial that met their needs and one clinical trial that met the needs of a hypothetical patient. Half of participants were assigned to use the standard database search engine; the other half interacted with a relational agent who facilitated the search by asking questions, helping to narrow down search criteria, and explaining characteristics of identified clinical trials. The relational agent was an animated female who used synthetic speech and non-verbal behaviors (such as hand gestures, facial displays, gaze, and use of props). Results revealed that participants in the relational agent group were more satisfied and pleased, and less frustrated with the search task than participants in the control group. Additionally, participants with low health literacy in the relational agent group were significantly better at identifying clinical trials for a hypothetical patient than participants with low health literacy in the control group.

In a related study, Gardiner, McCue, Negash, Cheng, White, Yinusu-Nyahkoon, Jack, and Bickmore [22] assigned 61 women to (1) a condition in which they interacted with a computerized relational agent who provided information on stress management, mindfulness, healthy eating, and physical activity or (2) a control condition in which they met for 60 minutes with a technician who reviewed education sheets about stress management, mindfulness, healthy
eating, and physical activity and were given a CD containing meditations and mindfulness exercises. Results showed that, compared to the control group, women who interacted with the computerized relational agent increased their fruit consumption and decreased their use of alcohol to cope with stress. They also made positive comments about their interactions with the relational agent such as, “She relates to my stress” and “She helped me relax.”

Chattaraman, Kwan, and Gilbert [23] created a relational agent to help older adults navigate through an online retail store. Sixty participants (M age = 69) were assigned to purchase a set of clothing on a mock website. Additionally, half of the participants were assisted by a relational agent (Gina) who interacted with them throughout the task. Results showed that the presence of a relational agent increased perceived social support, trust, and intentions to use the online store. Additionally, the effects of the agent on trust were mediated by perceived social support, and the effects of the agent on intentions to use the store were mediated by trust.

The effectiveness of relational agents has also been demonstrated by studies of social robots (i.e., robots that interact with humans and exhibit social behaviors; [24,25]. Like computerized relational agents, social robots have demonstrated acceptability and usefulness (24,26]. They also tend to elicit social behaviors and anthropomorphization. For example, de Graaf et al [24] conducted a qualitative study examining older adults’ acceptance of an in-home social robot (“Harvey,” a 12-inch tall rabbit with moving ears and blinking lights). The robot was designed to initiate at least three conversations per day with participants, and alternated between three states: sleeping, alert, and engaged (i.e. listening and talking). The robot was installed in each participant’s home for three 10-day periods. Afterwards, participants were interviewed about their experience and their responses were coded for content. Participants tended to attribute human-like qualities to the robot (“The rabbit itself was kind of sweet. If it
was furry, I would stroke it.”  “Because Harvey was Harvey, I talked to him as a male, and males do tend to get on your nerves from time to time…”). Participants also followed social rules, such as politeness, when interacting with the robot (e.g. “So whether it’s a machine that talks to you or somebody who’s going to stay, you have got to have some communication with them just out of sheer politeness and friendliness…”) and all but one participant noted Harvey’s potential for companionship (“I got used to the idea that it would greet me in the morning.”).

**Strengthening the Effects of Relational Agents**

Other research has focused on factors that strengthen the effects of computerized relational agents. In particular, some studies suggest that greater agent anthropomorphism and behavioral realism lead to higher-quality social interaction. For example, Gong [27] asked undergraduates to work through a series of social dilemma scenarios with a computerized agent. The agents represented four levels of anthropomorphism, ranging from humanoid robot characters to actual human faces. After completing the task, participants rated the agent on competency, trust, homophily, and social judgement. Results showed that, as the agent became more anthropomorphic, ratings in all domains became more positive. Similarly, Lee and Nass [28] asked undergraduates to participate in a conformity experiment with 1 to 4 fictional participants whose opinions were represented with a text box, a stick figure with a speech bubble, or a fully animated figure with facial expressions, body movements, and a speech bubble. Although the text box condition unexpectedly elicited the most conformity, the animated character was rated as the most trustworthy, competent, and socially attractive.

Notably, some studies in this area have yielded null results [29,30]. Others have failed to control for agent attractiveness or have confounded anthropomorphism with modality. That is, rather than varying anthropomorphism within modality (i.e. comparing faces or agents with varying levels of humanness), these studies compare text on the computer screen (the low
anthropomorphism) to faces or agents (the high anthropomorphic stimulus [27]). It should also be noted that the effects of anthropomorphism may be moderated by individual difference variables, such as need for social connection [31] or participant/agent ethnicity match [32]. Finally, some data suggest that when agents are too realistic (i.e. when they have a ‘near perfect human likeness), they can elicit negative reactions and cause discomfort (i.e. the ‘uncanny valley’ phenomenon [33,34]).

Another body of literature compares relational agents (animated figures whose speech and actions reflect computer algorithms) to avatars (animated figures whose speech and actions are controlled by a real person in real time). It is often assumed that avatars have more social influence than relational agents because they are controlled by real people (i.e. the “agency assumption”). However, research testing this assumption has yielded mixed results, with some studies finding that avatars elicit more social behavior than agents [35-37] and others finding no difference between the two types of digital representations [38]. Recent meta-analytic data suggest that avatars do, in fact have more influence over behavior than agents, but that the effect of agency (i.e. avatar vs. agent) is moderated by several variables including, task type (cooperative/competitive/neutral), level of immersion, subjective vs. objective dependent variables, and whether the representation is actually controlled by a human [39].

Implications for e-interventions

The findings reviewed above suggest that (1) humans automatically relate to computers/agents in social ways, (2) certain relational characteristics (anthropomorphism, agency, etc.) may strengthen the social response to computers/agents, and (3) relational agents with human-like qualities can facilitate behavior change. These findings have important implications for e-interventions and their therapeutic mechanisms. Specifically, they suggest that e-interventions--particularly those with anthropomorphic agents or avatars--may activate social
cognitions and expectations that may, in turn, affect intervention response. However, the degree to which these social reactions can be ‘harnessed’ to improve e-intervention efficacy is only beginning to be examined. In fact, only a small handful of studies have directly tested whether relational factors (e.g. empathy, positive regard, humor, genuineness) can increase the acceptability and/or efficacy of e-interventions.

In one of the few studies directly examining this question, Bickmore and Picard [18] assigned 101 healthy adults to work with one of three exercise promotion programs: a relational program, a non-relational program, and a control program. In all three programs, participants recorded their daily activity for 30 days. Participants in the relational program interacted with a computerized, relational agent who used social dialogue, empathic feedback, humor, and a variety of other relational behaviors. Participants in the non-relational program interacted with a computerized, non-relational agent who provided information about exercise in the absence of relational behaviors (i.e., she did not provide empathy, humor, dialogue, etc.). Participants in the control condition did not interact with a computerized agent. Results showed that participants liked, trusted, and respected the relational agent more than the non-relational agent. Additionally, participants expressed more desire to continue working with the relational versus the non-relational agent.

Berry, Butler and de Rosis [40] presented a healthy eating message to undergraduates using either text, a voice, a human actor, or a relational agent named GRETA. GRETA either (1) expressed emotion consistent with the message she was presenting (e.g. smiling while talking about health benefits), (2) expressed emotion inconsistent with the message she was presenting (e.g. looking concerned while talking about health benefits), or (3) did not express emotion (neutral condition). Participants rated evidence provided by the neutral version of GRETA as
more convincing, more trustworthy, and of higher quality than the evidence provided by the emotional versions of GRETA. However, participants had the greatest recall for the healthy eating message that was presented by the consistent emotion version of GRETA, suggesting that emotionally consistent facial cues may aid in encoding and recall.

Other studies have focused specifically on empathy in relational agents. For example, Brave, Nass and Hutchinson [17] instructed 96 participants to play a game of blackjack with a computerized relational agent. At the end of each blackjack round, the agent made one comment about his/her performance and one comment about the participant’s performance. Two primary variables were manipulated: the presence vs. absence of empathic emotion, and the presence vs. absence of self-oriented emotion (the authors also manipulated the gender of the agent). When empathic emotion was present, the agent made empathic comments about the participant’s performance after each round (“You won! That’s wonderful!”). When self-oriented emotion was present, the agent made emotional comments about his/her own performance after each round ("The dealer beat me, I’m disappointed"). When empathic and/or self-oriented emotion were absent, the agent’s comments were factual and did not contain emotion words (e.g. “I won” or “The dealer beat you”). At the end of the game, participants rated the agent on a variety of dimensions. Similar to Bickmore & Picard [18] and Berry et al. [40], empathic agents were rated as more caring, likeable, trustworthy, and supportive than non-empathic agents. In contrast, self-oriented emotion had little effect on perceptions of the agent.

In another direct test of agent empathy, Ellis, Grekin, Beatty, McGoron, LaLiberte, Pop, Kostecki, and Ondersma [41] examined whether expressions of empathy from an animated relational agent improved the efficacy of a brief, motivational intervention for alcohol use. One hundred heavy drinking undergraduates were randomly assigned to either a high or a low
empathy version of the intervention. In the high empathy intervention, a relational agent used standard motivational interviewing techniques and made a series of personalized, empathic reflections (“e.g., You really like the way alcohol helps you to relax.”). In the low empathy intervention, the agent used motivational interviewing strategies but did not make any empathic reflections. Intentions to reduce drinking were assessed both before and after the intervention and a change score was calculated. Similar to previously reviewed studies, results showed that participants who worked with high empathy relational agents felt more supported and less criticized than participants who worked with low empathy relational agents. Additionally, participants who worked with high empathy agents reported greater increases in intentions to reduce drinking over the course of the study than those who worked with low empathy agents. Thus, the presence of an empathic relational agent improved likeability and led to greater increases in intention to change alcohol use.

In sum, early studies imply that e-interventions can be effective, not just by providing information and/or skills training, but also by establishing a therapeutic ‘relationship’ with a client based on qualities such as respect and empathy. While more research is clearly needed, existing data are promising and suggest the potential for improving computerized intervention outcomes.

**E-interventions as a Platform for Testing Relationship Factors**

The studies reviewed above also highlight the methodological advantages of using e-interventions as a platform for testing relational factors. In particular, computerized interventions facilitate testing of relationship factors using random assignment. To date, virtually all common factors research has been correlational due to the practical and ethical barriers associated with manipulating common factors during in-person therapy (e.g., therapists cannot reliably alter their levels of empathy, positive regard etc., for clients in different study
conditions). As a result, it is unclear whether client traits elicit reactions from therapists (e.g., motivated clients may elicit more positive, empathic responses than unmotivated clients), or whether therapist behavior elicits reactions from clients (e.g. empathic therapists may elicit more motivation from clients). Additionally, it is unclear whether common factors are the cause or the result of a successful therapy outcome (e.g., does empathy cause less substance use or does less substance use elicit more empathy?). Software, on the other hand, can be easily programmed to include (or not include) common factors such as reflections, statements of affirmation, humor, etc. Moreover, clients can be randomly assigned to different versions of a computer program (e.g. a version with an empathic versus a non-empathic relational agent) with the knowledge that the computer will not be affected by the clients’ behavior in undesired ways. Thus, by using random assignment and systematically manipulating the presence of relationship factors in e-interventions, it is possible to examine associations between computerized interventions and common factors in a novel and effective way.

Future Research

Despite the widespread use of both e-interventions and relational agents, few studies have systematically examined ways in which relational factors affect the acceptability and efficacy of e-interventions. As the field moves forward, there are a multitude of potential investigative avenues. However, the following research designs may be particularly fruitful in providing information and helping to make e-interventions more powerful:

1. Studies directly comparing e-interventions with and without relational factors using random assignment to condition. Few studies have attempted these direct comparisons. Those that have done so have examined widely varying target behaviors, intervention techniques, and relational factors, making it difficult to generalize across studies or draw firm conclusions.
2. Studies examining how to best operationalize relational factors in the context of e-interventions. For example, what is the best way for a relational agent to express empathy? Are certain types of humor ineffective when expressed by a computerized agent? Can individuals perceive computerized agents as genuine? While many studies have used relational agents, few have systematically examined ways to operationalize the common factors expressed by these agents.

3. Studies examining interactions between relational factors. For example, it is possible that expressions of empathy work best when they are delivered by highly realistic agents who use gestures and dynamic facial expressions. Similarly, it is possible that a participant/agent therapeutic alliance can only be established when the role of humans in developing the agent is emphasized.

4. Studies examining the degree to which computerized relational factors interact with individual difference variables. It is possible that specific traits or characteristics (e.g., extraversion or loneliness) affect how individuals respond to computerized expressions of common factors. For example, individuals who are high in agreeableness may value empathy or humor within an e-intervention more than individuals who are low on these traits.

The above are but a few examples of how research regarding e-interventions could evaluate the potential role of common factors in facilitating key outcomes such as engagement, retention, and efficacy. Although a great deal more research is needed, it appears that incorporation of relational factors is a promising strategy that may make a meaningful difference in e-intervention efficacy.
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Conflicts of Interest
None declared.
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