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As social robotics becomes more utilized and routine in everyday situations, individuals will be interacting with social robots in a variety of contexts. Centered on the use of human-to-human interaction scripts, the current study hypothesized that individuals would be more uncertain, have less liking and anticipate less social presence when they are told that they will be interacting with a social robot as opposed to another person. Additionally, the current study utilized a two-time measurement model experiment to explore perceptions of interacting with either a robot or human. Data were consistent with hypotheses. Research questions examined perceptions from Time 1 to Time 2 for the robot condition on the dependent variables. Findings are discussed in light of future research studies.

Keywords: *Human–Robot Interaction (HRI); Impression Formation; Social Presence; Social Robotics; Uncertainty*

Imagine you are at South by Southwest (SXSW), looking through your Tinder profile, when you spot a beautiful 25-year-old named Ava. After you swipe right, Ava does as well, and you are off and chatting. Ava says she wants to get to know you and requests

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to ask you a few questions. Of course, you agree. Her questions are fairly deep, asking about what attracted you to her, whether you have ever been in love, where you would meet her, if it could be anywhere, and also what makes you human? Once you answer, Ava says you have passed her test. She tells you to check out her Instagram account to see if she passes your test.

Perhaps this sounds good to be true? Well, it is. It turns out Ava was a chat bot cleverly deployed to market the film *Ex Machina* (Heing, 2015; Warren, 2015), which debuted in the United States at SXSW. After answering questions and passing Ava's "test," swipers were directed to an Instagram account promoting the movie. The picture used in the Tinder profile was of the actor Alicia Vikander, who plays Ava in the film. Although Ava was "fake," interacting with social robots is a very "real" communication issue. Increasingly, social robots and humans will interact (Levy, 2008), prompting the question of what it means to be "human," anyway. Understanding more about the human–robot interaction process in the everyday context is an important consideration for researchers (Holmquist & Forlizzi, 2014). The current study hypothesizes that individuals will be more uncertain, have less liking and anticipate less social presence when they are told that they will be interacting with a social robot as opposed to another person. As such, this study replicates and extends the work of Spence, Westerman, Edwards, and Edwards (2014) by examining people's initial expectations for communication with a social robot and outlines future directions for research and practical implications of the findings.

Literature Review

For most everyday interaction, communication is essentially an automatic process occurring through the use of social scripts (Kellerman, 1992). Communication most often occurs between two or more people, but there is a growing amount of interaction between people and robots. It is important to understand how people think and feel about potential encounters with social robots and to identify the impressions and scripts subsequently formed (Powers & Kiesler, 2006). This is imperative because social robots differ from other forms of computer-mediated communication insofar as "they are not a medium through which humans interact, but rather a medium with which humans interact" (Zhao, 2006, p. 402). In other words, social robots can engage in two-way interactions and can coordinate their activities with humans (Duffy, 2003). Turkle (2012) found humans can develop deep bonds of affection and liking for social robots in a variety of contexts. Spence et al. (2014) suggested humans may eventually expect similar levels of interpersonal outcomes when talking to social robots or to people.

Cognitive script theory (Abelson, 1976, 1981; Schank & Abelson, 1977) proposes that people use cognitive scripts, or mental representations of real-world events that guide perceptions and behaviors, to help make decisions about future actions. Scripts help define the activities to be performed in a given action (Kollar, Fischer, & Hesse, 2006). Previous experiences allow individuals to be more efficient each time they enact a script. Essentially, prior interaction is internalized to update the template of the likely sequence of events. Priming, or cueing a particular schema, is an essential part of this process. Priming places an individual in a state of readiness to enact a particular cognitive script (Schleuder, White, & Cameron, 1993). Importantly, priming influences both attention and memory and impacts judgment formation (Carpentier, 2009). Scheufele (2000) argued that priming is based on attitude accessibility of a memory-based model of an information-processing system. In other words, a piece of information can prime an individual to utilize a cognitive script that will, in turn, initiate various attitudes and expectations.

In the interpersonal communication context, people expect to interact with another person and not with a machine or a robot. The Computers are Social Actors (CASA) paradigm argues that people often do treat computers similar to how people are treated (Reeves & Nass, 1996). However, individuals generally indicate they would not interact with computers in the same ways they would with other humans (Reeves & Nass, 1996). Although this study does not directly test this paradigm, the study does examine these initial expectations of interaction. The anthropocentric biases of initial expectations for interaction are sensible because they are based on historical modes of relating and long-established means of satisfying physical and social needs. Spence et al. (2014) termed the initial expectation and preference for communication with another person over a robot the "human-to-human interaction script" (p. 277). The human-to-human interaction script is based, in part, on differing expectations about the degree of uncertainty, liking, and social presence to be experienced with human versus robot conversation partners.

Although human–robot communication is increasing, it is not yet the norm of interaction, and the various levels of these expectations should vary based on whether a person is primed for a human or social robot interaction. Indeed, Spence et al. (2014) found expectations of liking and social presence were lower, and uncertainty higher, when people were told they would be interacting with a robot rather than a person. However, their study did not provide participants with any information about the robot or the person with whom they would be interacting. By design, this left participants to rely on their various mental representations of a robot or a person when formulating expectations for the upcoming interaction. The current study primed participants with a concrete image of a person or a robot to determine the influence on expectations of liking, social presence, and uncertainty. The revised methodology standardizes participants' picture of the partner about whom they are asked to form communication expectations. This eliminates some of the variance in the previous experiment that may have been linked to participants' discrepant mental images of a robot (e.g., Disney's Baymax versus The Terminator) or of a person (e.g., male versus female). This experiment utilized a two-time measurement model to explore more about possibilities of a human-to-robot interaction script and to establish a baseline of human and robot interaction expectations. Finally, the current method will help determine whether visual priming (versus the merely verbal priming employed in the previous study) influences interaction expectations and scripts.

Uncertainty

Expectancy violation theory (EVT; Burgoon, 1978, 1993) maintains that individuals have expectancies about others before the interaction takes place. Based on the human-to-human interaction script, people will likely expect interpersonal interactions to be with another person. If some part of the interaction script violates the held expectations, a person will most likely experience an increase in uncertainty. Uncertainty reduction theory (URT; Berger & Calabrese, 1975), which is a parent theory of EVT, helps explain initial interactions in the interpersonal communication context. Communication practices are the key process to reduce uncertainty in a situation (Goldsmith, 2001). The chief assumption of URT is that an individual strives to reduce uncertainty to help increase the predictability of a stranger's behavior. Kellerman and Reynolds (1990) have suggested that "as the target's behavior becomes more deviant, level of uncertainty increases" (p. 67). If an individual possesses a script for interaction with other people but is told to interact with a robot, higher uncertainty should result. In agreement with the findings of Spence et al. (2014), we predict that people will have higher uncertainty when expecting to interact with an unknown (stranger) who is a robot versus another person:

> H1: Individuals expecting to interact with a robot will report more uncertainty than will individuals expected to interact with another person.

Additionally, it can be expected that the level of uncertainty to decrease after individuals are provided information about their conversational partner. For example, people likely experience less uncertainty once they have viewed a photo of a person with whom they will interact. The same effect may hold for people's uncertainty about conversing with a robot, but has yet to be tested:

> RQ1:Will individuals report altered levels of uncertainty once they have viewed a picture of their robot partner?

Liking

Social proximity, or the idea that individuals perceive similar others as closer to themselves socially than dissimilar others, is an important part of liking in an interpersonal situation (Heider, 1958; Miller, Downs, & Prentice, 1998; Tesser, 1988). Similarity is also important for liking in human–computer agent interactions. Baylor and Kim (2004) demonstrated that when the physical appearance of an avatar was similar to humans, the participant functioned better on an assigned task than when their assigned avatar was more cartoonish. Behrend and Thompson (2011) examined the impact of similarity with human–computer agent interaction and found that participants worked better with and preferred an agent that was similar to them. However, too much similarity between a robot and a human can cause individuals to dislike the robotic entity. Mori (1970) argued that when a robot becomes too anthropomorphic, a person's perception of the robot can shift from likable to unsettling. Known as the "uncanny valley," this experience occurs when a robot looks sort of human, but not human enough and, thus, appears creepy. Without much exposure to social robots and little in the way of conversational scripts, people might be likely to evaluate the idea of communication with a social robot as unsettling and think they will not like the experience. The basic finding that individuals like similar others along with expectations about the human-to-human interaction script indicate that people will anticipate higher levels of liking for another human conversational partner than a robot conversational partner. In line with Spence et al. (2014), we offer the following hypothesis:

> H2: Individuals expecting to interact with a robot will anticipate lower levels of liking than will individuals expecting to interact with another person.

Additionally, anticipated liking might increase after initial exposure to the stimulus picture of the robot because of lowered uncertainty. However, individuals might also feel more nervous and anticipate less liking because the partner is revealed to be a robot. Thus, the second research question asks:

> RQ2:Will individuals report altered levels of anticipated liking once they have viewed a picture of their robot partner?

Social Presence

Because humans tend to apply social models when interacting with robots (Breazeal, 2003), the perception of social presence is an important area to consider. Originally, social presence theory (Short, Williams, & Christie, 1976) suggested that social presence was based on the number of cue systems that a channel provides. More recently, social presence has been characterized more as a psychological concept (Nowak & Biocca, 2003). For the purposes of the current study, social presence is defined as "a sense of being with another" (Biocca, Harms, & Burgoon, 2003, p. 456) without noticing the technological means of providing this psychological sense (Lee, 2004).

Because scripts about conversation hold a human-to-human bias, it is logical that people will anticipate lower feelings of social presence of a robot interaction partner than of a human interaction partner. Thus, the following is predicted:

> H3: Individuals expecting to interact with a robot will anticipate lower social presence than will individuals expecting to interact with another person.

The lowered uncertainty associated with having visual information about a prospective partner may lead to an increase in social presence expectations for human–robot interactions. But, this effect has not been established in previous studies.

> RQ3:Will individuals report altered levels of anticipated social presence once they have viewed their robot partner?

Method

Participants

The convenience sample was composed of 145 undergraduate students enrolled in a variety of communication courses at a large Midwestern university and a large

Southern university. Participants included 89 females (61.4%), 52 males (35.9%), and 4 who did not indicate sex (2.8%). The majority of participants self-identified as White/Caucasian (75.2%, $n = 109$). Participants' ages ranged from 18 to 48 years, with a mean of 23.47 ($SD = 5.82$).

Procedures

To test the hypotheses and research questions offered in this study, an experiment was conducted. Upon securing informed consent, participants were randomly assigned to one of the two conditions (human or robot conversation partner). Participants were brought into a room and informed they would be assigned a conversational partner. Participants were asked to complete a Time 1 questionnaire assessing their expectations about the upcoming conversation and partner. Next, the specific identity of their assigned conversational partner was revealed by providing an image of either a human or robot. The research assistant pointed to a camera in the room and informed the participant that an identical camera was in the other room with their conversational partner. Participants were then shown a tablet that had camera-viewing software on it. The tablet provided an image of a human sitting in a chair or a robot with a humanoid robot face on the screen. Participants had about 30 seconds to view the tablet. Participants were again requested to fill out of the questionnaire (Time 2) regarding expectations for the upcoming conversation and partner. Finally, participants were informed they would not actually interact with their assigned partner and were thanked and debriefed.

Instruments

The questionnaire contained measures of uncertainty about the upcoming interaction, anticipated interpersonal liking, and social presence. Parks and Floyd's (1996) five-item measure of uncertainty (e.g., "I am very uncertain about what this person/robot is really like") achieved acceptable internal reliability coefficients (Time 1: $M = 2.51$, $SD = 0.78$, $\alpha = .78$; Time 2: $M = 2.21$, $SD = 0.74$, $\alpha = .71$). Anticipated liking was assessed with six items from McCroskey and McCain's (1974) measure of social attraction (e.g., "I think my conversational partner [the robot] could be a friend of mine"); reliability at Time 1 was $\alpha = .71$ and reliability at Time 2 was $\alpha = .76$ (Time 1: $M = 3.48$, $SD = 0.46$; Time 2: $M = 3.14$, $SD = 0.72$). Social presence was measured with six items modified from Walther and Bazarova (2008). Each item (e.g., close/distant) was measured on a 7-point semantic differential response option. This scale was reliable (Time 1: $M = 3.75$, $SD = 1.11$, $\alpha = .88$; Time 2: $M = 4.67$, $SD = 1.31$, $\alpha = .89$).

Results

In order to test the hypotheses in the study, independent samples *t* tests were run for each of the three outcome variables of interest. First, uncertainty was hypothesized to be lower for those expecting to interact with a person than with a robot. The *t* tests were run at Time 1 to ensure there were no existing differences between the conditions and then at Time 2 after the intervention revealing an image of either a robot or a human (see Table 1). Results suggest that at Time 1, there were no difference between people in the human condition and those in the robot condition. At Time 2, results indicate that participants in the human condition experienced less uncertainty than those in the robot condition. Thus, the data are consistent with Hypothesis 1.

It was also hypothesized that participants who expected to interact with another person would report higher anticipated liking than would those who expected to interact with a robot. Results at Time 1 indicate that there were no difference between participants in the human condition and participants in the robot condition. At Time 2, results indicate that participants in the human condition experienced more liking than participants in the robot condition. Thus, the data are consistent with Hypothesis 2.

Finally, it was hypothesized that participants who expected to have a conversation with a human would experience higher levels of anticipated social presence than participants expecting to communicate with a robot. Results at Time 1 indicate no difference between the human condition and participants in the robot condition. At Time 2, results suggest that participants expecting to communicate with a human experienced more social presence than participants expecting to have a conversation with a robot, so the data are consistent with Hypothesis 3.

For the research questions, analyses were run for each of the variables under consideration within the robot condition at Time 1 and Time 2. In the robot condition, participants reported less uncertainty at Time 1 (M = 2.45, SD = 0.75) than Time 2 (M = 2.07, SD = 0.78), $t(78) = 4.38$, $p < .001$ $\eta^2 = .20$ (data reverse scored). There was more liking reported at Time 1 (M = 3.46, SD = 0.45) than Time 2 (M = 2.82, SD = 0.68), $t(78) = 7.44$, $p < .001$, $\eta^2 = .42$. Finally, participants experienced more social presence at Time 1 (M = 3.90, SD = 1.19) than at Time 2 (M = 5.04, SD = 1.27), $t(75) = -6.36$, $p < .001$, $\eta^2 = .35$ (data reverse scored). In other words, after knowing that that they would be interacting with robot, participants reported more uncertainty, less liking, and less social presence.

Table 1 Effects of Partner Type (Human vs. Robot) On Initial Expectations for Interaction

Variable	Time	Group 1 (*M, SD*)	Group 2 (*M, SD*)	*t*	*df*	*p*	η^2
Uncertainty[a]	1	Human (2.62, 0.82)	Robot (2.43, 0.74)	1.45	148	.149	.01
	2	Human (2.38, 0.67)	Robot (2.07, 0.78)	2.47*	144	< .01	.40
Liking	1	Human (3.47, 0.45)	Robot (3.49, 0.48)	−0.188	146	.851	.01
	2	Human (3.55, 0.57)	Robot (2.80, 0.71)	6.978**	146	< .001	.25
Social Presence[a]	1	Human (3.63, 1.10)	Robot (3.87, 1.18)	−1.364	143	.175	.00
	2	Human (4.21, 1.20)	Robot (5.05, 1.27)	−4.024**	(141)	<.001	.10

[a] Variables reversed scored.

*$p \leq .01$. **$p \leq .001$.

Discussion

Understanding expectations in human–robot interaction (HRI) is important for future possibilities in HRI. As more social robots are sold in the marketplace, people will interact with these robots in a variety of contexts. This study is a step towards understanding expectations and interaction scripts. Spence et al. (2014) were the first to examine the various levels of expectations about anticipated communication with a robot. The current study extended on their work by comparing levels of uncertainty, liking, and social presence at two different times and allowed for comparisons once the conversational partner was known. This permitted the baseline of expectations to be further established.

In general, all hypotheses were supported for the current study. Participants reported lower uncertainty and higher liking and social presence when expecting to communicate with another person than those who expected to interact with a robot, and, thus, the data were consistent with all three hypotheses. These findings are consistent with Spence et al. (2014) but add further evidence for the findings through the use of comparisons of Time 1 (participants were only told that they would have a conversational partner) and Time 2 (participants received an image of their conversational partner). Thus, the idea that people have expectations of interactions based on human-to-human scripts finds increased support in the current study. Future studies in this line of research will examine these expectations using actual communication with robots. The question then becomes: Will these initial expectations be overcome through actual human–robot interaction?

The Computers as Social Actors (CASA) paradigm (Nass, Steuer, Tauber, & Reeder, 1993; Reeves & Nass, 1996) argues that people will interact with computers similarly to how they would interact with others. However, people will say that they do not respond the same to computers as humans (Reeves & Nass, 1996), even though a long line of research shows that they often do treat computers similar to how they treat other humans. There has been some evidence to support CASA in the HRI domain (Kim, Park, & Sundar, 2013; Park, Kim, & Del Pobil, 2011). Although the current study does not address this aspect, it does demonstrate that people have different expectations for interactions with humans and social robots. If CASA holds firm for HRI, expectations will have to be increased after the first interaction. A social robot will be expected to show more human-like characteristics than a computer without violating uncanny valley norms (Mori, MacDorman, & Kageki, 2012). Future studies will examine these variables to see if liking and social presence can be increased while uncertainly can be decreased after reported exposure and interaction.

It is entirely possible that a social robot might produce a positive expectancy violation and score higher than in a human-to-human-interaction encounter because expectations were low at first and then positively violated. While not directly tested, Turkle's work with medical social robotic animals would support this notion (Kidd, Taggart, & Turkle, 2006). Future studies are being developed along these lines. In the current study, participants reported more uncertainty, less liking, and less social presence after knowing, in visual form, that they would be expected to interact with a robot. The current study suggests that individuals will need more exposure than simply a picture of a robot. The degree of robotic presence in society will likely influence perceptions and reduce levels of uncertainty felt in interacting with social robots.

One of the limitations of the current is study is the use of a photograph of a robot. Social robots take on many different forms ranging from computer to humanoid to animals. As such, these different visual cues might influence the measured variables in the study. The current study used a robot form chosen for its wide accessibility/adoption (a screen with presence capabilities on a moveable platform) and its low likelihood of entering the uncanny valley. However, it is possible that style of the robot might violate expectations and alter the conversational scripts. Kielser, Powers, Fussell, and Torrey (2008) found that people engaged more with more anthropomorphic robots than other types of robotic agents. Future studies need to explore these possibilities.

Both education and health care are natural contexts to explore HRI. The classroom has many applications for HRI (Park et al., 2011). We can expect that as social robots are used more in education, students will be more familiar and accepting of HRI. Instructional communication variables, such as learning, immediacy, student motivation, and competence, will all be important markers of effective HRIs. Additionally, social robots and telepresence robots will also have a direct impact on health care in the coming years (Broadbent et al., 2010). Robots could be used for routine health care tasks or emotional support (Robinson, MacDonald, & Broadbent, 2014). Understanding the general perceptions of uncertainty, liking, and social presence is an important step towards creating effective and positive HRIs in these environments. The current study provides general baselines for the next steps in this research program.

Although not tested yet, it seems likely that a combination of CASA and social information-processing theory (SIPT; Walther, 1992) might be a useful approach to studying HRI. SIPT suggests that individuals can attain similar levels of interpersonal outcomes in a computer-mediated environment, given adequate amounts of time and interaction. Westerman, Van Der Heide, Klein, and Walther (2008) argue that there may be pieces of information that can speed up (or potentially slow down) this process and may start the process at different levels to begin with. People's expectations about a conversation (whether a social robot or human) could serve as one of these starting points in an interpersonal communication context, and the current study (as well as the previous study by Spence et al., 2014) suggests that knowing that one is about to interact with a robot starts an interaction off with reduced interpersonal expectations. However, as SIPT would suggest in computer-mediated communication, time and interaction might allow a person to overcome those initial limits and get to a point where HRI equals human-to-human interaction in terms of outcomes such as liking, uncertainty, and social presence. This is conjecture at this time and future research can explore this possibility.

Zhao (2006) writes, "This emerging movement of social roboticization is causing a fundamental change in the meaning of social interaction and the nature of human communication in society" (p. 402). As such, this study provides the necessary baseline for these interactions. Moreover, as these interactions become more commonplace, it is important to utilize communication research to help create positive encounters for human–robot interaction (Torrey, Fussell, & Kiesler, 2013). The current research agenda will seek these answers. The findings of this study support the idea of a general human-to-human interaction script. As companies build new robots for various tasks and organizations implement them for their advantages, it appears that needed research should examine how to reduce the preference for this script and how robot manufacturers may consider campaigns to help the public become more comfortable with the idea of interacting with a robot. As technologies expand and mature, robots will be programmed to learn through social interaction with humans and thus to adjust to their emotional responses (Lee, Park, & Song, 2005; Matsumura, Shiomi, Miyashita, Ishiguro, & Hagita, 2014; Nicolescu & Matarić, 2001). Additionally, future research should examine the specific type of conversations that individuals are expecting with a robot. Perceptions might vary based on whether it is a help-seeking conversation or a conversation about the work environment. We are currently designing future studies that will aid in this effort. Creating campaigns to help humans adjust to their interactions with robots is an area that communication scholars are uniquely situated to explore.

References

Abelson, R. P. (1976). Script processing in attitude formation and decision making. In J. S. Carroll & J. W. Payne (Eds.), *Cognition and social behavior*, 33–45. Hillsdale, NJ: Erlbaum.

Abelson, R. P. (1981). Psychological status of the script concept. *American Psychologist*, *36*, 715–729. doi:10.1037/0003-066X.36.7.715

Baylor, A. L., & Kim, Y. (2004). Pedagogical agent design: The impact of agent realism, gender, ethnicity, and instructional role. In J. Lester, R. Vicari, & F. Paraguaçu (Eds.), *Intelligent tutoring systems* (Vol. 3220, pp. 592–603). Berlin/Heidelberg, Germany: Springer.

Behrend, T. S., & Thompson, L. F. (2011). Similarity effects in online training: Effects with computerized trainer agents. *Computers in Human Behavior*, *27*, 1201–1206. doi:10.1016/j.chb.2010.12.016

Berger, C. R., & Calabrese, R. J. (1975). Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Research*, *1*, 99–112. doi:10.1111/hcre.1975.1.issue-2

Biocca, F., Harms, C., & Burgoon, J. K. (2003). Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence*, *12*, 456–480. doi:10.1162/105474603322761270

Breazeal, C. (2003). Toward sociable robots. *Robotics and Autonomous Systems*, *42*, 167–175. doi:10.1016/S0921-8890(02)00373-1

Broadbent, E., Kuo, I. H., Lee, Y. I., Rabindran, J., Kerse, N., Stafford, R., & MacDonald, B. A. (2010). Attitudes and reactions to a healthcare robot. *Telemedicine and E-Health*, *16*, 608–613. doi:10.1089/tmj.2009.0171

Burgoon, J. K. (1978). A communication model of personal space violation: Explication and an initial test. *Human Communication Research*, *4*, 129–142. doi:10.1111/j.1468-2958.1978.tb00603.x

Burgoon, J. K. (1993). Interpersonal expectations, expectancy violations, and emotional communication. *Journal of Language and Social Psychology*, *12*, 30–48. doi:10.1177/0261927X93121003

Carpentier, F. (2009). Effects of priming social goals on personal interest in television news. *Journal of Broadcasting & Electronic Media*, *53*(2), 300–316. doi:10.1080/08838150902908114

Duffy, B. R. (2003). Anthropomorphism and the social robot. *Robotics and Autonomous Systems*, *42*, 177–190. doi:10.1016/S0921-8890(02)00374-3

Goldsmith, D. J. (2001). A normative approach to the study of uncertainty and communication. *Journal of Communication*, *51*, 514–533. doi:10.1111/j.1460-2466.2001.tb02894.x

Heider, F. (1958). *The psychology of interpersonal relations*. New York, NY: Wiley.

Heing, B. (2015, March 16). Welcome to the future: Why this woman's Tinder profile is messing with people's minds. *Hello Giggles*. Retrieved from http://hellogiggles.com/tinder-profile-sxsw

Holmquist, L. E., & Forlizzi, J. (2014). Introduction to journal of human-robot interaction special issue on design. *Journal of Human-Robot Interaction*, *3*, 1–3. doi:10.5898/JHRI.3.1.Holmquist

Kellerman, K., & Reynolds, R. (1990). When ignorance is bliss: The role of motivation to reduce uncertainty in Uncertainty Reduction Theory. *Human Communication Research*, *17*, 5–75. doi:10.1111/j.1468-2958.1990.tb00226.x

Kellerman, K. L. (1992). Communication: Inherently strategic and primarily automatic. *Communication Monographs*, *59*, 288–300. doi:10.1080/03637759209376270

Kidd, C. D., Taggart, W., & Turkle, S. (2006). A sociable robot to encourage social interaction among the elderly. In *Robotics and Automation*, 2006. ICRA 2006. Proceedings 2006 IEEE International Conference on (pp. 3972–3976). Orlando, FL: IEEE.

Kiesler, S., Powers, A., Fussell, S. R., & Torrey, C. (2008). Anthropomorphic interactions with a robot and robot-like agent. *Social Cognition*, *26*, 169–181. doi:10.1521/soco.2008.26.2.169

Kim, K. J., Park, E., & Sundar, S. S. (2013). Caregiving role in human–robot interaction: A study of the mediating effects of perceived benefit and social presence. *Computers in Human Behavior*, *29*, 1799–1806. doi:10.1016/j.chb.2013.02.009

Kollar, I., Fischer, F., & Hesse, F. W. (2006). Collaboration scripts — A conceptual analysis. *Educational Psychology Review*, *18*, 159–185. doi:10.1007/s10648-006-9007-2

Lee, K. M. (2004). Presence, explicated. *Communication Theory*, *14*, 27–50. doi:10.1111/comt.2004.14.issue-1

Lee, K. M., Park, N., & Song, H. (2005). Can a robot be perceived as a developing creature? *Human Communication Research*, *31*, 538–563. doi:10.1111/j.1468-2958.2005.tb00882.x

Levy, D. (2008). *Love and sex with robots: The evolution of human-robot relationships*. New York: Harper Perennial.

Matsumura, R., Shiomi, M., Miyashita, T., Ishiguro, H., & Hagita, N. (2014). Who is interacting with me?: Identification of an interacting person through playful interaction with a small robot. *IEEE Transactions on Human-Machine Systems*, *44*(2), 169–179. doi:10.1109/THMS.2013.2296872

McCroskey, J. C., & McCain, T. A. (1974). The measurement of interpersonal attraction. *Speech Monographs*, *41*, 261–266. doi:10.1080/03637757409375845

Miller, D. T., Downs, J. S., & Prentice, D. A. (1998). Minimal conditions for the creation of a unit relationship: The social bond between birthmates. *European Journal of Social Psychology*, *28*, 475–481.

Mori, M. (1970). The uncanny valley. *Energy*, *7*, 33–35.

Mori, M., MacDorman, K. F., & Kageki, N. (2012). The uncanny valley. *IEEE Robotics and Automation Magazine*, *19*, 98–100. doi:10.1109/MRA.2012.2192811

Nass, C., Steuer, J., Tauber, E., & Reeder, H. (1993, April). Anthropomorphism, agency, and ethopoeia: Computers as social actors. In S. Ashlund, K. Mullet, A. Henderson, E. Holnagel, & T. White, (eds.), *INTERACT'93 and CHI'93 Conference Companion on Human factors in computing systems* (pp. 111–112). New York, NY Association for Computing Machinery.

Nicolescu, M. N., & Matarić, M. J. (2001). Learning and interacting in human-robot domains. *Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on*, *31*(5), 419–430. doi:10.1109/3468.952716

Nowak, K. L., & Biocca, F. (2003). The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence*, *12*, 481–494. doi:10.1162/105474603322761289

Park, E., Kim, K. J., & Del Pobil, A. P. (2011). The effects of a robot instructor's positive vs. negative feedbacks on attraction and acceptance towards the robot in the classroom. In B. Mutlu, C. Bartneck, J. Ham, V. Evers, & T. Kanda (Eds.), *Social Robotics ICSR 2011. LNCS* (pp. 135–141). Berlin, Germany: Springer. doi:10.1007/978-3-642-25504-5_14

Parks, M. R., & Floyd, K. (1996). Making friends in cyberspace. *Journal of Communication*, *46*, 1–17. doi:10.1111/j.1083-6101.1996.tb00176.x

Powers, A., & Kiesler, S. (2006, March). The advisor robot: Tracing people's mental model from a robot's physical attributes. In *Proceedings of the 1st ACM SIGCHI/SIGART conference on human-robot interaction* (pp. 218–225). New York, NY: Association for Computing Machinery. doi:10.1145/1121241.1121280

Reeves, B., & Nass, C. (1996). *The media equation: How people treat computers, television, and new media like real people and places*. Stanford, CA: Center for the Study of Language and Information.

Robinson, H., MacDonald, B., & Broadbent, E. (2014). The role of healthcare robots for older people at home: A review. *International Journal of Social Robotics*, *6*, 575–591.

Schank, R., & Abelson, R. (1977). *Scripts, plans, goals, and understanding: An inquiry into human knowledge structure*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Scheufele, D. A. (2000). Agenda-setting, priming, and framing revisited: Another look at cognitive effects of political. *Mass Communication & Society*, *3*(2/3), 297–316. doi:10.1207/S15327825MCS0323_07

Schleuder, J. D., White, A. V., & Cameron, G. T. (1993). Priming effects of television news bumpers and teasers on attention and memory. *Journal of Broadcasting & Electronic Media*, *37*(4), 437–452. doi:10.1080/08838159309364234

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London, United Kingdom: John Wiley.

Spence, P. R., Westerman, D., Edwards, C., & Edwards, A. (2014). Welcoming our robot overlords: Initial expectations about interaction with a robot. *Communication Research Reports*, *31*, 272–280. doi:10.1080/08824096.2014.924337

Tesser, A. (1988). Toward a self-evaluation maintenance model of social behavior. *Advances in Experimental Social Psychology*, *21*, 181–227.

Torrey, C., Fussell, S. R., & Kiesler, S. (2013, March). How a robot should give advice. In *Human-Robot Interaction (HRI), 2013 8th ACM/IEEE International Conference on* (pp. 275–282). Piscataway, New Jersey: Institute of Electrical and Electronics Engineers.

Turkle, S. (2012). *Alone together: Why we expect more from technology and less from each other*. New York, NY: Basic Books.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research*, *19*, 52–90. doi:10.1177/009365092019001003

Walther, J. B., & Bazarova, N. N. (2008). Validation and application of electronic propinquity theory to computer-mediated communication in groups. *Communication Research*, *35*, 622–645. doi:10.1177/0093650208321783

Warren, C. (2015, March 17). "Ex Machina" viral marketing campaign trolls Tinder while winning SXSW. *Mashable.com*. Retrieved from http://mashable.com/2015/03/16/ex-machina-tinder-marketing/

Westerman, D., Van Der Heide, B., Klein, K. A., & Walther, J. B. (2008). How do people really seek information about others?: Information seeking across Internet and traditional communication sources. *Journal of Computer-Mediated Communication*, *13*, 751–767. doi:10.1111/j.1083-6101.2008.00418.x

Zhao, S. (2006). Humanoid social robots as a medium of communication. *New Media & Society*, *8*, 401–419. doi:10.1177/1461444806061951