Theatre and Robots - Envisioning Interdisciplinary Collaborations Beyond the Stage

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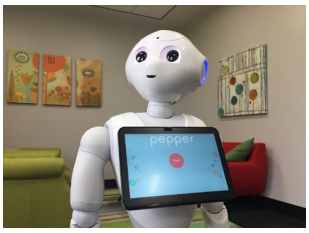
Abstract

An interdisciplinary team representing Theatre-Liberal Arts, Social Work, Kinesiology, and Engineering academic units collaboratively envisioned and conducted an innovative study designed for caregivers of adult children with intellectual and developmental disabilities (IDD) to interact with a socially assistive robot (SAR) and develop an approach to providing temporary respite for older adult caregivers. The transformative perspective to engage and include young adults with an interactive SAR respite scenario involved a programmable robot (employing computer science and engineering), and a multi-modal narrative, based in theatrical methodological theory, infused with insights from social work, kinesiology, and engineering. Although the theatrical approach of the narrative is primarily described in this article, it is the interdisciplinary approach among the multiple team members that yields a transformative solution.

Keywords

Theatre, interdisciplinary, socially assistive robot (SAR), intellectual or developmental disabilities,



Pepper, Emotional Robotics Living Lab

Introduction

An interdisciplinary team of university faculty and graduate students representing Theatre-Liberal Arts, Social Work, Kinesiology, and Engineering academic units collaboratively envisioned and conducted an innovative study designed for caregivers of adult children with intellectual and developmental disabilities (IDD) to interact with a socially assistive robot (SAR). As an interdisciplinary team, we worked collaboratively to jointly frame and address a

common interest (i.e., Adya, 2015; Ameredes, et al., 2015; Darbellay, et al., 2014) - to develop an innovative approach to providing temporary respite for older adult caregivers. Interdisciplinary research is associated with transformative innovation, and a transformative process that integrates knowledge in such a way as to produce novel understanding (Hesse-Biber, 2016; Rice, et al., 2017). The transformative approach to engage and include young adults with an interactive SAR respite scenario involved a programmable robot (employing computer science and engineering), and a multi-modal narrative, based in theatrical methodological theory, infused with insights from social work, kinesiology, and engineering. Early in the design phase of the project the team identified several domains for which a theatre perspective would make a critical contribution. First, previous studies have shown that proxemics – how space and distancing influence communications, comfort and relationships – have a bearing on human and robot interactions (Mumm & Mutlu, 2011), as do relative positions (i.e., frontal vs. lateral placement) with reprecussions for socio-emotional bonding and engagement (Papadopoulos, et al., 2016). In the context of longer in-home interactions, such as we might anticipate with respite robots, a study by de Graaf and colleagues found that the robot's attractiveness, social presence, and enjoyment were factors in long-term acceptance (de Graaf, et al., 2016). Our study sought to address these considerations and incorporate design features fostering social presence, appropriate proxemics and placement, with enjoyable interactions, and an attractive robot learning scenario. The theatrical approach was key to achieving these aims.

Although the theatrical approach of the narrative is primarily described in this article, it is the interdisciplinary approach among the multiple team members that yields a transformative solution. The narrative story that the SAR recited was conceived and based on foundations of the Three-Act Structure, generally attributed to be originally conceived by Aristotle, and sourced

throughout literature by Shakespeare, Moliere, Chekhov, and others, and currently as recently as the late 1970s for cinema-making (Field 1979). Three-Act Structure broadly frames three portions of a narrative story labeled as the Set-up, Confrontation, and Resolution. Specifically, our story featured a Set-up, usually referred to in the theatre as exposition, followed by a dramatic conflict or confrontation, eventually allowing the participant with IDD to learn a lesson of resilience, anxiety-coping mechanisms, and companionship through the resolution. Multi-sensory domains of aural, physical, visual, affective, and story-making text perspectives were created to support the dramatic structure. In this way, the application of the theatre methodology theory working in tandem with our diverse and collaborative disciplines, developed a multi-modal experience of engagement between the young adult with IDD and the SAR for the respite of their adult caregivers. Data were gathered through semi-structured qualitative interviews and quantitative analysis.

The emergent technological confluence of theatre, social work, kinesiology, computer science and engineering provides an innovative and potentially transformative examination of how a social robot might enhance engagement for young adults with IDD, providing respite for their caregivers. The interdisciplinary nature of the team was particularly significant to the framing of the study and, more specifically, to the development of the narrative.

The care of young adults with developmental disabilities who live with their older (50+) parents is a complex issue needing a variety of interdisciplinary solutions (Brennan 2017). As parents age, the ability to care for their children is taxed (Fujira 2014). Caregiver respite is a significant issue in healthcare and in long-term disability communities. Additional resources are needed to provide adequate respite care for children with IDD and their parents (Genik, et al., 2020). Our interdisciplinary team sought to examine innovative solutions in this exploratory

study as a collaborative University of Texas at Arlington – University of Minnesota, Twin Cities research project within the Georgia Tech Rehabilitation Engineering Research Center for Wireless Inclusive Technologies (WIT RERC), funded by the National Institute on Disability and Independent Living Research (NIDILRR*)*. Interdisciplinary teams are promoting the potential of new methods of inquiry to spur innovative research, "Participatory theatre as a research method involves both participants and researchers in articulating their desires for social transformation, democratizing the research process and the relationships between researchers and participants" (Erel, et al., 2017). In this essay, the theatre methodologies were programmed through the sensory modalities of sight, sound, speech, emotion, and physicality. The team developed the narrative to highlight themes of resilience and companionship between the SAR and the IDD care recipient, reiterating the team's objective of temporary respite for older adult caregivers.

The narrative that was created by the team was developed out of pre-focus group interactions between the theatre collaborator, interdisciplinary team members, and the parents of the young adults with IDD. We structured the actions within the intervention to broadly explore respite concepts the robot may perform such as 1) limiting the supervision required by the parent of the young adult child, 2) programming the SAR to be a tool in reducing repetitive behavior and, 3) accompanying, or playing with the young adults and performing companion-like relational concepts drawn from theatre methodology theory that highlight connection, engagement and/or relational interaction.

This article is primarily focused on the role played by the narrative that highlights the applied theatre methodologies transforming the structure of human-robot communication to a more nuanced, subtle exercise. This is needed to capture the complex issues surrounding human

social communication and awareness. The traditional term of "applied theatre" references theatre-based methodologies and exercises that exist and are meant to be applied outside the typical and traditional performance platform of a live stage event.

One such specific caregiver request included the SAR's ability to provide a distraction for repetitive behavior and the physical movement from one location to another. The narrative was introduced with a change of location suggestion for the SAR to perform and for the young adult with IDD to interact with. In that way, the narrative was the significant catalyst in preventing repetitive behavior. The team did not intend to infringe on the parent's autonomy and relationship with their young adult children, but rather fill a gap in caretaking that potentially may allow the older parent respite to undertake their role with renewed stamina. This is a reproducible research perspective for a community and society that may benefit from robot human interactions and companionship. The team anticipates that the analysis of theatre techniques in research studies will continue to inform and provide innovative foundations for the programming of SARs as potential companions for young adults with IDD as they age.

A. Inclusion, Innovation, Transformation

This study is not the first to integrate engineers, artists, researchers, and computer scientists (Hoffman 2011, Jochum 2016, Lu 2011); however, this interdisciplinary team furthers the positive collaborative possibilities of applied theatre methodologies that fundamentally support research and examination of the innovative solutions occurring from interdisciplinary collaborations. This emerging use of applied theatre and social robotics is unique, inclusive, innovative, and transformative. This article, by articulating the interdisciplinary research study for temporary caregiver respite, advances the role of applied theatre in healthcare domains and STEM-centric disciplines.

B. Materials and Methods

The interdisciplinary team submitted an Institution Research Board (IRB) protocol governing the conduct of human participant research which was approved. Caregiver-care recipient participant dyads were recruited from a local private school for individuals with Down Syndrome and similar intellectual or developmental disabilities. Eleven (11) dyad participants completed the study and qualitative analysis at the close of the study. The study took place at University of Texas at Arlington's Emotional Robotics Living Lab providing a space for the interaction of the SAR, young adults with developmental disabilities and their caregivers who viewed an approximately 15-minute interview from a separate room through a streaming video process. The use of streaming video was intended to make the entire scenario and SAR-young adult learning collaboration transparent in real time. This set up was important in providing the caregiver with assurances not only of appropriate and helpful interactions, but also in orienting family members to how the robot provides care, as a further basis for trust, and as an affirmation of their values, and wishes (Johansson-Pajala, et al., 2020).

The Emotional Robotics Living Lab (ERLL) at the University of Texas at Arlington dedicates a portion of its space to a home-like environment in order to bridge the gap between standard lab facilities and participant's homes. The use of physical space and the arrangement of furnishings was purposeful and calibrated to promote comfort and ready engagement with the SAR, while also appealing aesthetically.

The interaction between the SAR and the young adult was one-on-one with several research team members in the same room to assure the safety of the participants and the completion of the intervention. The team in the lab included an engineering graduate student overseeing technical operations, a director of the lab and professor of Theatre initializing the

introduction of the SAR to the young adult, and a professor of Kinesiology providing support and guidance for the young adult during the multi-step intervention.

Safety for the participants was a fundamental concern, consequently a blue circle was placed on the floor encircling the robot to extend a visual limit to the participant's proximity to the robot. The blue circle also served as a marker for the adult child with IDD, setting off the space for interaction from the space reserved for the SAR. Participants were encouraged to fist bump, not hug the SAR, after observing a team member mirror the fist bump physicality with the SAR. The Softbank Robotics Pepper© (Figure 1 below) unit was the SAR chosen for its humanoid shape and features, communication attributes, and safety and maturity in the social robotics market. Pepper is an approximately 4 ½ foot tall humanoid SAR weighing 65 lbs. It is a fully programmable social robot used in research, industry, and education. The robot includes a tablet located on its chest which can be used for visual communication through programmable text or figures. The design for text for the narrative story below was developed for the cognitive level appropriate of an 12-13 aged young adult.

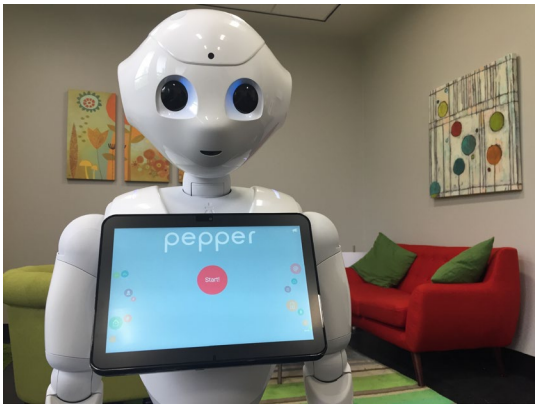


Figure 1 Pepper, (SAR) Emotional Robotics Living Lab, UTA, Greer photo

The design of the narrative includes the creation of text, aural sound modalities, visual modalities, physicality, and affective elements. In this way the team consistently brought innovative interdisciplinary perspectives and approaches to the programming between the IDD

participant and the SAR. These design components emphasized the facilitation of temporary respite for an older adult caregiver, assuaging safety concerns while also providing a stimulating, inviting and engaging learning environment for their adult child.

B.1 Narrative

The text of the narrative was an interdisciplinary collaboration based on text-based themes of resiliency, communication, connectedness, and anxiety mitigation as guided through a multimodal sensory platform. The story is recited with the robot verbally speaking narrative text aligned with aesthetically pleasing visual images appearing on the SAR's tablet. The text of the study follows:

> **"It was a beautiful morning, and the sun was shining and birds chirping happily. It was my first day of school. I was so excited to meet new friends and to learn many new things. But I was a little scared too.**
>
> **When I arrived at school, I became a little anxious. It seemed like everyone did things different than me. The teacher tried to help, but I was still a little sad. This continued for a few days.**
>
> **Suddenly, one fine day, a friend like you, showed up and we ate lunch together. The music you played made me feel happy. I felt like a superhero and was happy being with you. I enjoyed moving, dancing, and playing with you, my friend. And I liked this robot dance. When I went to school to the next day, I talked to the teacher and even smiled at the other students. That felt good, too. My friend and I do many things. We even go shopping for groceries. There are days when I am a little down, but friends like you always make it better. That was my happy little story. I would love to hear a story about you, now. Would you like to tell me a story? You can say yes or no."**

B.2 Text

The text of the story is conveyed by a first-person narrator describing an exciting, albeit, complex event - the first day of school. It was essential to the team to not present a homogeneousness story narrative of cliché emotion or to hurriedly disregard the difficulties that may occur on this significant day in a young person's life. "**It was my first day of school. I was so excited to meet new friends and to learn many new things. But I was a little scared too."**

Theatrical methodology and theory cannot exist without some form of conflict and both excitement and trepidation can exist in the same moment. The interdisciplinary team maintained the story's narrative strive to reveal the complexities and nuance of the young adult participant's emotions that may occur on an event as significant as the first day of school. In the text below, conflict, support, and emotional realism are noted in two ways. Affirmative words are coded in green, and include: beautiful, shining, happily, excited, learn, help, happy, superhero, happy, enjoyed, liked, smiled, good, better, happy, and love (16 words total). Negative words are coded in red and include: scared, anxious, different, sad, and down and are coded in red (5 words total). Linguistic resources were utilized with the term "a little" before negative terms. "A little" quantifies the meaning of the word for listeners to allow a larger range of affective connection and customizes the text for participants to feel both "scared" or "a little" scared (Hakulinen, ed. and et al., 2005).

> **"It was a beautiful morning, and the sun was shining and birds chirping happily. It was my first day of school. I was so excited to meet new friends and to learn many new things. But I was a little scared too.**
>
> **When I arrived at school, I became a little anxious. It seemed like everyone did things different than me. The teacher tried to help, but I was still a little sad. This continued for a few days.**
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In addition to understanding theatrical literature as a sign system which codes and defines its meaning in multiple modes (Aston, et al., 2002) the narrative text was purposefully created to provide dynamic tension, and theatrical conflict (Heim, 2016) between affirmative and negative

words. The addition of the dual emotions in a single event led to the narrator's realization that they may experience a sense of being different or of being an outsider, and at this point, do not feel the camaraderie of friends, but rather the emotional tone of an outcast or outsider. This narrative concept is not meant to assume all young adults with developmental disabilities would feel scared the first day of school. It is a trope that demonstrates that all humans from time-to-time feel ostracized as a reaction to a particular situation. "**It seemed like everyone else did things differently than me."** Although the young adult has support from the teacher, they still feel sad. The text introduced a new type of friend, a friendly, social robot. The visual is a cartoon robot meeting a young adult. **"I enjoyed moving, dancing and playing with you, my friend!"** This text illustrates that a SAR has the potential to fill a gap and complement human companionship and become a friend to a young adult with developmental disabilities. A programmable social robot integrated to provide companionship for a young adult with disabilities can provide the temporary caregiver respite and needed support for communication and resilience in difficult situations. "**...even smiled at the other students. That felt good, too."** Finally, the story again reiterates the narrative conclusion that a companion SAR is not going to take away all difficult emotional situations and events that make us scared and anxious, but it allows more comfort and security to encourage the young adult to interact more fully with others during stressful times.

B.3 Aural Modality

The aural sensory modality of the study was a significant contributor to the overall presentation of the narrative. There were two major aural areas in which the participant interacted with the SAR and they were 1) Pepper's programmable voice tone and pitch, and 2) a digital classical music accompaniment to the text.

B.3.a Tone in voice production is the characteristic subjective understanding of the meaning of the words. Pitch in voice production is the range between low and high tones. The Pepper SAR voice can be programmed to fit a variety of vocal pitches from low to high. A low range of pitch has been associated with authority (Lowen, 2011). A higher range of pitch is associated with a younger, child-like personality. A combination of pitch and tone components can simultaneously imply complex social communication "a robot with a child's voice was more likely to be perceived having an extroverted, passionate, and relaxed personality. (Dou, et al., 2019). The team determined a higher-tone voice was appropriate for the SAR in order to encourage connectedness between the IDD participant and the robot.

B.3.b The classical music accompanying the text set a mood for the story not unlike a soundtrack in a cinematic feature. Two separate pieces were selected. The first selection was chosen for its soothing, affirmative tone. The piece played continually until the sentence "**Suddenly, one fine day…"** At that time the second piece began and seamlessly flowed into an upbeat, energized musical movement which reflected the affective change in the story from anxiety to well-being. Current research has indicated that aural studies in human-robot interaction are understudied, most specifically in the realm of affective communication. A hearing/aural modality may have significance beyond our primary vision modality, "voice-only communication increases empathic accuracy over communication and across senses" (Krause, 2017). Consequently, utiziling voice and pitch in digital voices may lead to better engagement, trust, and connection in human-robot interactions.

B.4 Visual Modality

The visuals in the study were presented on the SAR-mounted tablet and ran concurrently with the textural story, augmenting meaning of the narrative and creating unique meaning to the

narrative. The visual modality included animated graphics of a sunrise, birds chirping, friends dancing, multiple cartoon superheroes, a school, a sad, anxious face, and a robot. The tablet screen on the SAR was approximately two feet from the seated participant which approximated eye-level for the young adult. The choice of brightly colored, animated figures was used to engage and animate the textual aspects of the story. Current research in graphic animation for robot communication includes culling the 12 principles of animation from the golden age of Walt Disney animators (Schulz, 2019). “Animation techniques (for HRI) improves an individual’s interaction with robots, improving the individual’s perception of qualities of a robot, understanding what a robot intends to do, and showing the robot’s state or possible emotion.” The use of static or moving visual to intensify and heighten the affective communication between a human and a robot has interdisciplinary roots. that the team was encouraged to support in the creation of the narrative’s visuals on the tablet for the understanding and meaning of the IDD participant.

B.5 Physical Modality

The physical modality that accompanies the narrative is developed through the parent pre-focus group meetings. A desire on the behalf of the parents was to create a robotic physicality that interrupted repetitive behavior. The was created through the robot moving from one location to another location in the lab encouraging the IDD participant to join them. In our study the participants freely moved with the SAR to the Emotional Robotics Living Lab couch and back again to the center of the lab. Other physical interactions included a fist bump. The fist bump was programmed after interdisciplinary deliberation to allow the participants interact with the Pepper SAR in a safe, fun, and engageable manner. It was determined a handshake was too formal and a hug was not safe, as the SAR has moving joints and limbs which could capture the

clothing of the young adult with IDD. The major physical components of the study included fist bump, gestures during the narration of the story, and breaking repetitive behavior by moving from one location to another in the lab.

B.6 Affective Communication

Affective and emotional communication in recent affective computing studies encourage the understanding and application of emotion in human-machine interactions (Breazeal, 2004, Franzoni et al., 2019), particularly as an aid to learning (Cuadrado, et al., 2016). The use of affective human-robot connection through the narrative was of primary significance to the team. The interdisciplinary team focused on themes of resiliency, companionship, friendship, and human-robot interactions to encourage an affective connection between the IDD and the SAR. The team postulated the development of engaging, trustworthy emotional content between the IDD participant and the Pepper SAR would significantly impact the study. The parent groups spoke to the affective companionship qualities needed in a SAR to be successful for temporary respite and connection with their children. Family 8 stated, "It allows peace of mind. I can walk out of the room, I can walk out of the house, I can even run to the store without worrying about 24/7. And now, yes, is she okay if something happens? Does she know how to call? But Pepper is there and could fill…It takes so much weight. That's the value" (mother caregiver, female)."

C. Discussion

Post-study qualitative interviews with the caregiver and care-recipient connected the affective quality, as well as the communicative nature of the narrative to a personal and positive individual response for both members of the dyad. "It was amazing. And I thought the story…it was so, so, so emotional" (Family 1 CR, female). Another participant remarked how the interaction of telling a story – robot to human and human to robot – allowed the care-recipient to enjoy the

narrative portion of the intervention in a specific and meaningful way, “It was amazing how he told his story, and you know, and how I told my story…I was actually excited because when I was looking at him, um, he kind of like read me, like an actual book” (Family 2 CR, male). And finally, a caregiver expressed great interest in narrative uses for the interaction and that it was a manner of communication that their child (young adult) was especially fond of, “…She loves books so having a story read to her…she loves to be read to and stuff…” (Family 8 caregiver, female). The addition of a multi-modal narrative based in theatrical methodological theory and combined with insights from social work, kinesiology, and engineering is an effective asset for collaboration in an interdisciplinary research study. So too were the considerations of scene and setting as informed by a theatrical approach. The findings of this proof-of-concept study on SAR as a temporary respite provider make a good case for integrating a theatre perspective into interdisciplinary research on human-robot interactions.

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References

Adya, M., Temple, B.K., & Hepburn, D.M. (2015). Distant yet near: promoting interdisciplinary learning in significantly diverse teams through socially responsible projects. *Decision Sciences Journal of Innovative Education, 13*(2), 121-149.

Ameredes, B.T., Hellmich, M.R., Cestone, C.M., Wooten, K.C., Ottenbacher, K.J., Chonmaitree, T., Anderson, K.E., & Brasier, A.R. (2015). The multidisciplinary translational team (MTT) model for training and development of translational research investigators. *Clinical Translational Science, 8*, 533-541.

Aston, E., & Savona., G. (2002). *Theatre as Sign System: A Semiotics of Text and Performance*. Routledge: New York.

Breazeal, C. (2003) Emotion and sociable humanoid robots. *International Journal Human Computer Studies*. 59(1–2), 119–155.

Brennan, D., Murphy, R., McCallion, P., & McCarron, M. (2017). What's going to happen when we're gone? Family caregiving capacity for older people with an intellectual disability in Ireland, *Journal of Applied Research in Intellectual Disabilities*, 31, 2, (226-235).

Cuadrado, L.E., Riesco, A.M., & Lopez, F. (2016). ARTIE: an integrated environment for the development of affective robot tutors. *Frontiers of Computing Neuroscience*. https://doi.org/10.3389/fncom.2016.00077

Darbellay, F., Moody, Z., Sedooka, A., & Steffen, G. (2014). Interdisciplinary research boosted by serendipity. *Creative Research Journal, 26*(1), 1-10.

De Graaf, M.A., Allouch, S.B. & van Dijk, J.A. (2016). Long-term evaluation of a social robot in real homes. *Interaction Studies 17*, 461–490.

Dou, X., Wu, C.F., Lin K.C., & Tseng, T.M. (2019) The Effects of Robot Voice and Gesture Types on the Perceived Robot Personalities. In: Kurosu M. (eds) Human-Computer Interaction. Perspectives on Design. HCII 2019. *Lecture Notes in Computer Science*, vol 11566. Springer, Cham. https://doi.org/10.1007/978-3-030-22646-6_21

Erel U., Reynolds, T., & Kaptani, E. (2017). Participatory theatre for transformative social research. *Qualitative Research*. 17(3):302-312. doi:10.1177/1468794117696029

Franzoni, V., Milani, A., Nardi, D. & Vallverdu, J. (2019) Emotional machines: the next revolution. *Web Intelligence*, 17. 1– 7.

Fujiura, G., (2014). The political arithmetic of disability and the american family: a demographic perspective, *Family Relations*, 63(1), (7-19).

Genik, L.M., Millett, G.E., & McMurtry, C.M. (2020). Facilitating respite, communication, and care for children with intellectual and developmental disabilities: Preliminary evaluation of the Caregiver Pain Information Guide. *Clinical Practice in Pediatric Psychology, 8*(4), 359–368.

Hakulinen, A. & Selting. M. (2005). *Syntax and lexis in conversation: studies on the use of linguistic resources in talk-in-interaction*. Amsterdam Benjamins.

Heim, W. (2016). Theatre, conflict and nature. *Green Letters*, 20:3, 290-303.

Hesse-Biber, S. (2016). Doing interdisciplinary mixed methods health care research: Working the boundaries, tensions, and synergistic potential of team-based research. *Qualitative Health Research, 26*(5), 649-658.

Hoffman, G. (2011) On stage: robots as performers. *RSS 2011 Workshop on Human-Robot Interaction: Perspectives and Contributions to Robotics from the Human Sciences*. Los Angeles, CA. Vol. 1.

Johansson-Pajala, R.M., Thommes, K., Hoppe, J.A., Tuisku, O., Hennala, L., Pekkarinen, S., Melkas, H., & Gustafsson, C. (2020). Care robot orientation: What, who and how? Potential users' perceptions. *International Journal of Social Robotics, 12*, 1103–1117. https://doi.org/10.1007/s12369-020-00619-y

Kraus, M. (2017). Voice-only communication enhances empathic accuracy. *American Psychologist*. 72(7), 644-654.

Lowen, L. (2019). Do women with lower voice pitch achieve greater success? Accessed June 20, 2019. https://www.thoughtco.com/women-lower-voice-pitch-authority-success-3533843

Lu, D., & Smart, W. (2011). Human-robot interactions as theatre. *2011 RO-MAN. IEEE*.

Mumm, J., & Mutlu, B. (2011). Human-robot proxemics: Physical and psychological distancing in human-robot interaction. *Proceedings of the 6th International Conference on Human-Robot Interaction*, 2011-03-06, p.331-338. ACM 978-1-4503-0561-7/11/03.

Papadopoulos, F., Küster,D., Corrigan, L.J., Kappas, A., & Castellano, G. (2016). Do relative positions and proxemics affect the engagement in a human-robot collaborative scenario? *Interaction Studies 17*(3), 321–347. doi 10.1075/is.17.3.01pap

Rice, E., Petering, R., Stringfellow, E., & Craddock, J.B. (2017). Innovations in community-based and interdisciplinary research: A network perspective on innovation in social work science. *Research on Social Work Practice, 27*(2), 189-193.

Schulz, T., Torresen, J., & Herstad, J. (2019). Animation techniques in human-robot interaction user studies: A systematic literature review. Association for Computing Machinery, New York, Vol 8, no. 2.

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