Public Versus Private: How Teens Perceived Teen-Robot Interactions in a School Setting

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Abstract—Social robots may be a promising social-emotional tool to support adolescent mental health. However, how might interactions with a social robot in a school setting be perceived by teens? From previous studies, we gathered qualitative data suggesting a design tension between teens wanting both public and private interactions with our social robot, EMAR. In our current study, we explored interactions between a social robot and a small group of adolescents in a semi-private, school library setting. We found: (1) Some teens preferred to have a friend present while they engaged with the social robot, (2) Teens found comfort in being physically visible, but audibly private during interactions, and finally (3) Strangers in the school environment were not disruptive of the teens' robot interactions, but unexpectedly friends were. After presenting these findings, we briefly discuss how these qualitative data can be situated and our next steps for further exploration.

Index Terms—human-robot interaction, social robots, adolescents, privacy

I. INTRODUCTION

Today's adolescents are a unique population unlike children or adults [1] and are currently suffering from a mental health crisis [2]. Social robots may be an appropriate and engaging tool to support teen mental health if designed appropriately. However, the successful development of social robots relies on strong consideration for the context of the robot setting and its intended users [3].

Social robots show promise as supportive tools in educational settings [4] and for the purpose of mental health support [5]. School is an accessible and appropriate access point for mental health support for teens [6]. However, if we hope for social robots to be supportive for the purpose of teen mental health in a school setting, the implementation of the robot and its behaviors needs to be designed with the school environment and teens in mind. Adolescents are a diverse and individualized population. If we hope to develop appropriate and adoptable social robots for this unique population, adolescents must be participants in social robotics research to ensure the acceptance of therapeutic social robots.

II. RELATED WORK

Social robots have been found a desirable medium for teens to share their stress data [7] and have been shown to reduce stress in adolescents [8], [9]. However, successful longitudinal deployment of a social robot requires further consideration of teens' specific needs and preferences in a school setting.

Self-disclosure in front of classmates involves risks (e.g., harassment) and benefits (e.g., acquiring friends), as shown in past research [10]. A social robot that protected privacy by not sharing user's information was found more trustworthy [11]. In our own work exploring teen's interactions with our social robot EMAR, we learned that for some teens, being alone with the social robot promotes a successful interaction. In contrast, qualitative data has highlighted teens' discomfort with entering a private environment where they would be alone interacting with a social robot. They compared that kind of interaction to *confession* and suggested it was inappropriate for the school setting.

Privacy as it relates to human-robot interactions in the school setting is important. In particular, teens' perceptions of appropriate behaviors and interactions is likely to change between private and public settings. Therefore, the current study aims to qualitatively explore the tension between public versus private interactions in designing social robot and its settings.

III. METHODS

After receiving institutional board approval, we recruited 13 teens to engage in a participatory, open-ended study exploring the concept of public and private interactions and settings with our social robot, Ecological Momentary Assessment Robot (EMAR). Data was gathered in person, on site at their school during two monthly research study sessions (January and February, 2020).

In October of 2019, the research and design team visited an urban high school to share with teens information about the

project and the design process. During the January session, the research and design team led the participants in a discussion about the appropriate location for "public" and a "private" interactions with EMAR. We also led an open discussion exploring the following questions:

- What questions do you have about privacy when considering interacting with a social robot at school?
- What barriers can you imagine that might keep someone from participating in our study?

Teens discussed these questions in the group and used post-it notes to articulate their ideas about what felt public and what felt private to them. See Table I for more detail.

In the February session, we wanted the teens to have embodied experiences of teen-robot interactions to see how this affected their perception of public and private. Therefore, we visited the high school to implement the social robot in the school library (as suggested during the previous session with teens). See figure 1 for a photo of the social robot in the school library setting. The teens then took turns interacting with the teleoperated social robot in the library setting. They took the roles of *passive* (aware of the robot interaction, but engaged in a separate activity), *active* (paying close attention to the robot interaction/not engaged in a separate activity), and *aggressive active* (engaging with the speaker during the interaction) observers as well as robot interaction speakers. The purpose of these observer roles was to simulate observers. Given this was a school setting, there were also actual observers who were not part of the study session.

The robot was teleoperated by a researcher to perform a simple active listening session to elicit a stressor from the teen and to provide empathetic responses. The teleoperation of EMAR during an active listening session was found engaging and effective at reducing stress in our previous studies [8], [9], [12]. After introducing itself, the robot prompted the speaker by asking, "Would you like to share a stress story with me?" When the speaker finished sharing, the robot showed empathetic responses, such as "I'm sorry to hear that" or "That sounds very stressful." The robot interaction also included probes such as, "Do you want to tell me more about that?" and "How did that make you feel?"

Teen participants were given a choice to interact with the robot as a speaker or as one of the observer roles. Speakers were also given the choice to include a friend with them during the interaction. In the session, we conducted four different teen-robot interactions.

A. Sample

Our sample included 13 teens from a local area high school Girls Who Code club. The teens ranged in grades 9-12 (m=10.69, sd=.85) and ages 14-17 (m=15.69, sd=.95). The teens all self-identified their genders as "female" and ethnicities included Asian (n=2), Indian (n=1), Bangladeshi (n=1), Chinese (n=2), Mexican (n=1), and White (n=6).

Fig. 1. Photo of EMAR in the high school library setting.

IV. RESULTS

A. Public Versus Private Interactions

From the January 2020 study session, we learned that the concept of public and private when it comes to teen-robot interactions in a school setting is complex. The teen's variety of suggestions for placement of EMAR in their school fell into two categories, small spaces centered around mental health and larger communal spaces.

For EMAR's location in their school, some of the teens suggested placement in smaller spaces that are centered around health. This included the Teen Health Center and the counseling office. However, upon further discussion of these locations, we found opposition. One teen felt the "Counselor's office has space for [a] private talk, but it does not feel private because you are never alone." Another teen wrote that these locations fit under types of "bad public" spaces where one would be in a "mildly busy pretty quiet area but still [have] people around." Four different participants noted that these smaller spaces would feel private is if the participant was alone. But even with this privacy, another teen suggested she would be uncomfortable if someone witnessed her in a private space. Therefore, the tension between public and private was validated.

The alternative group of suggestions were for larger communal spaces such as the lunchroom and library. A teen stated that interacting with EMAR in a loud lunchroom with lots of students around could feel quite private. At certain hours, our teens noted these spaces qualified as "good public" spaces because they are "larger room[s] with more people," "crowded," and "noisy." To further explain this concept, a teen noted if it is busy, people around you are talking, and there is so much overlapping noise; it is private because no one is paying attention to you. These findings guided us to selecting the school library as the environment for the main study session in February. In addition to guidance on location, our discussion with the teens in this study presented many other interesting findings around private and public concepts.

See Table I for more detail illustrating the range of interactions the teens in this study perceived as public or private.

Public Concepts	Private Concepts
A space is public if the user knows other people commonly go there.	Being in an empty space by oneself with a social robot is private.
People actively or having the ability to observe the user feels public.	Being seen purposefully seeking privacy is awkward.
Being heard feels public.	When observers are unable to hear what the user is saying, it feels private.
Being in the center of a space is more public.	Being "out of the way" with the robot's screen turned towards a corner is private.
Discussing intense, emotional and vulnerable topics makes the interaction feel public.	Discussing casual topics or things that are commonly spoken about feels private.
Speaking to a social robot with strangers or acquaintances makes the interaction public.	Diversity in the social robot's conversation topics prevents others from assuming what the user is talking about and gives the conversation privacy.
A good kind of public interaction is being accompanied by someone else (specifically friends) in the interaction.	Being around people the user knows well and trusts feels private.
The interaction is public when the user feels self conscious about being noticed by others and cannot convey authentic thoughts and feelings.	Having the freedom to express oneself and be authentic is a part of privacy.
A bad public space is a quiet space with only a few people around.	A large noisy space with many people around gives privacy to the user.
Directly interacting with the robot: physical contact or face-to-face contact feels public.	Privacy is having control over passage of information (mute button, data privacy, etc.).

a Statements are not general and instead speak for our sample group of teens.

B. Responses to Teen-Robot Interactions in Situ

Through the main study in February 2020, we determined three interesting findings regarding public versus private interactions among our teens and the social robot, EMAR. As we began the study, we discovered our teens wanted to interact with EMAR in a pair or group. During the post-interaction data collection, we found privacy is determined by how much can be heard. Finally, we learned the existing relationship between the user and observers can determine how disruptive observers will be to the speaker. Disruption further plays into the sense of privacy in the interaction.

C. Teens Want Social Interactions

As a social robot, EMAR was designed for one-on-one interactions with participants. These were found successful in previous studies [8], [13]. However, while exploring the concept of public versus private interactions, teen wanted to talk to the robot with their friends instead of alone. This was the first evidence for the interesting finding that our teens want to engage with social robots together. As the study was in action one of the teens mentioned it was uncomfortable speaking to EMAR at times, but "it did make it better that I was with someone." Despite the teens' desire for communal communications, the interactions did not always run smoothly because they were designed to be one-on-one. One pair of speakers interacting with the robot stated "especially where there [are] two people, it is hard to talk with EMAR because [it] could only talk to one person at a time." This caused another teen to question "how would EMAR tell when the second person wants to talk." This is an important question because it reveals our teens' communal interactions require the social robot to know when different speakers wish to speak. Additionally, the interactions should be redesigned to have a natural flow in a communal context because gaps in speaking left our teens disengaged and more aware and uncomfortable by their surroundings. A teen expressed, "I kept on noticing people around me so I kept on thinking about the people around me. Because there was a lot of space between the time I spoke and when EMAR responded." In redesigning for communal context, reduction of gaps in speaking may ease the fear of judgment from observers and promote a more successful interaction. Our next finding spoke on other requirements for our teens can feel a sense of privacy and therefore lack of judgment, despite the physically public nature of interacting with a community robot.

D. Visibly Public Audibly Private

As teen suggested in our January session, teens were okay with being seen interacting with robots. However, audibly quiet interactions were essential for teens using the social robot in the school setting in which there were likely to be observers. Observers determined privacy by how much they could hear the conversation. One active observer stated, "It was public, but it also seemed private because I could not hear anything from them." Six other observers made similar comments desiring audible privacy for a truly private interaction. Additionally, observers paid more attention to the robot's voice-over appearance. One observer stated, "Since EMAR was in a corner, it did not catch my eye and seemed as if it blended into the environment." Whereas four other observers noted the robot voice was one of the most significant things they recalled from the interaction. Teens in the speaking roles agreed with prioritizing audible privacy. One stated "I feel like speaking while everyone else is quiet... felt like everyone was listening." Further reassurance of audible privacy is determined by how disruptive observers are to the interaction.

E. Respectful Strangers and Disruptive Friends

Lack of disruption from observers reassured the teens in this study that their interaction with the robot is private. When reflecting on the private-ness or public-ness of their experience speaking to EMAR one teen noted "there is privacy and no one interrupted me." The existing relationship between the user and observers can determine how disruptive observers are. The participants in this study were all acquainted with each other through the school club; however, some were uncomfortable impeding on each other's privacy or were simply uninterested

in watching others interact with the robot. An observer to the singular solo speaker interaction stated, it "felt really awkward when I made eye contact [with the speaker]. [It] made me want to walk away." This contrasted with her thought process during the interaction, which she described as "the private-ness made me want to be more nosy to figure out what was happening." These statements show that the discomfort in interjecting overrides any interest in listening to the conversation. Another observer described their thought process, "I was not going to interject." These statements show it is unlikely our teens would interrupt another user's interaction with the robot unless it was actively distracting them from their work. Our small study also showed that EMAR was not distracting passive observers in the library. Seven participants expressed being "bored" and "uninterested" in the interaction. However, these data came from teens that were lightly acquainted with one another. Data from interactions between closer friends was quite different.

If the speaker was their friend, teens were more interested in disrupting the interaction with the social robot. After being given the role of the aggressive active observer, one teen wrote "[I] feel mischievous, [and] wanted to tease my friends [the speakers]." While the other active observer's thought process was "'Oh I know them, what are they doing?' When I saw my friends, I wanted to go over there." The presence of these aggressive active observers changed the sense speaker's sense of privacy. One teen stated, "it felt extremely public because I was with all my friends." Previous findings revealed public-ness in a space can be good or bad, but this public experience of aggressive active witnesses had distinctly negative effects on the interaction. It disengaged the speaker and left them frustrated. One of the speakers with an aggressive active observer stated "it was very chaotic. I no longer cared what I really had to say." While the other more directly commented on the aggressive active observer's behavior saying "certain people were aggressive and annoying which was not super nice. We should have a water bottle to spray them with." The contrast between acquaintances and friends leads us to believe that with this group of teens, the less familiar an observer is with the speaker, the more likely they are to be respectful and give privacy to the speaker's interaction with a social robot.

V. Limitations

This study is limited by its small sample, all of which identified as female. Although these findings are embedded in a rich ecological context, they cannot be easily generalized to other settings or populations. In addition, this study is limited in its single session design and forced roles for participants. A longitudinal design in which the robot was deployed for a period of weeks into the school setting would likely result in more contextually organic findings.

VI. Conclusion

From our previous work and this current study, the concept of public and private robot interactions appear nuanced and complex. Although studies have explored teens' preferences in relation to the privacy of their data, [14], [15], if we hope to design social robots that are engaging and appropriate for teen-robot interactions, it is imperative that we better understand the needs and desires of teens when it comes to where and how these interactions take place. Our preliminary findings suggest that public and private preferences may differ based upon the individual teen or their environmental context.

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