An Exploration of a Social Robot as a Digital Shield for Law Enforcement Interviews: Designing a Prototype

Cryston Sahae, Shuyue Gu, Lige Yang, Elin A. Björling, Nichelle Song

University of Washington: Department of Human-Centered Design and Engineering, 428 Sieg Hall Campus Box 352315 Seattle, WA 980195

Abstract. Sexual assault (SA) is a pervasive societal issue, particularly affecting minors, women, and members of the TGQN (transgender, genderqueer, nonconforming) community. Widespread underreporting, fueled by a deep-seated mistrust of law enforcement, particularly among women, creates a formidable barrier, hindering survivors from seeking deserved justice and support. This paper presents the potential benefit of a social robot as a non-judgmental and supportive data-gathering technology, as a crucial tool in addressing the pervasive issue of retraumatization experienced by survivors of sexual assault during police interviews. The paper explores the preliminary design of social robots as digital shields, offering a supportive and non-judgmental space for survivors to disclose their experiences by analyzing the development process, user research, ideation, and concept testing of two robot prototypes: *IRA* and *Pup*. We underscore the potential for social robots and innovative technologies to enhance the support provided to survivors within the criminal justice system.

Keywords: Social robots, Human-robot interaction, Trauma, Retraumatization, Sexual assault support, Emotional support social robot

1 Introduction

Sexual assault remains a profoundly disturbing societal issue, with substantial physical and emotional consequences for victims, deeply affecting their recovery and quality of life. The psychological impact of sexual assault is enduring and can be exacerbated by the processes involved in reporting the crime, often leading to what is known as retraumatization [1]. This occurs when the necessary interactions with law enforcement and judicial institutions intensify the survivor's trauma, pointing to deeper systemic flaws in handling such sensitive cases [2]. Scholarly research emphasizes the critical role of formal reporting in holding offenders accountable, preventing further crimes, and accessing essential health and psychological services, which can lead to more positive recovery outcomes [3,4].

The need for innovative strategies to support and protect survivors during the reporting process is urgent. Improvements in the criminal justice system's responsiveness and sensitivity are crucial to creating an environment that supports survivors and validates their experiences. This involves reforming reporting procedures, enhancing the response of institutions, and broadening the support network for survivors to promote a more equitable and empathetic approach to handling sexual assault cases.

1.1 Problem Background and Statistics

Looking through the sexual assault reports of law enforcement agencies, we see that the number of victims is enormous. Within the United States, it is estimated that 20% of all women are victims of completed or attempted rape, and over 43% of women in the US have faced some form of contact sexual violence, according to findings from the National Intimate Partner and Sexual Violence Survey (NISVS) [5]. This data includes cases that were reported either formally or informally, underlining the widespread nature of these offenses. Moreover, the National Crime Victimization Survey (NCVS) reports a concerning trend: despite a slight decline in the rates of sexual violence from 2018 to 2019, the overwhelming majority of these crimes, about 66%, are not reported to law enforcement [6].

Additionally, we have found that according to the U.S. Department of Justice, the age profile of sexual assault victims varies depending on the nature of the crime, but younger people are at the highest risk of sexual assault [7]. Disturbingly, juveniles constitute the majority of victims in offenses; more than two-thirds (67%) of all sexual assault victims who came forward to law enforcement were minors (those who were younger than 18 at the time of the crime) [7]. Despite females experiencing the highest rate of sexual violence, other genders are affected by sexual violence as well. A report on the AAU Campus Climate Survey on Sexual Assault and Sexual Misconduct in 2015 points out that 21% of TGQN (transgender, genderqueer, nonconforming) college students have been sexually assaulted, compared to 18% of non-TGQN females and 4% of non-TGQN males [8]. This data underscores the alarming prevalence of sexual assault among young children, women, and the TGQN community, emphasizing the urgent need for effective and empathetic approaches in handling such cases. Because SA disproportionately impacts children, the TGQN community, and women, the research team felt it was crucial to address this issue in a way that mitigates the risk of

re-traumatization for survivors and gives them the support they otherwise may not receive when reporting to police.

1.2 Motivation

The majority of sexual assaults are not reported to police. According to the National Crime Victimization Survey, only 310 out of every 1,000 sexual assaults are reported to the police, which means nearly 70% of sexual assault crimes go unreported [9]. Although there are some inconsistencies in the data due to differences in the statistical methods used in different research, they do not detract from the seriousness of the problem and the urgent need for victims to seek protection from the legal system. Sexual assault is a nationwide and all-gender-affected social issue. The reporting of sexual assault victims is an even more critical and complex step, which causes more victims to be ignored, hidden, and marginalized.

Many victims of sexual assault choose not to report for various reasons, and a significant roadblock in this decision-making process is a deep-seated mistrust of the police. Women, in particular, may feel discouraged to report because they believe that the police may dismiss or downplay their traumatic experiences as not constituting sexual assault [2]. Monroe et al. (2005) conducted a study involving 125 adult survivors who sought assistance from 19 sexual assault centers in Maryland. The study found that 30% of these survivors proceeded to press charges, with 46.2% of the reporting survivors expressing dissatisfaction with their interactions with the police [10]. Negative past experiences with the police contribute to a lack of trust in reporting, as victims may believe that nothing substantial will change or that their concerns will not be taken seriously [11]. Although formal reporting of SA crimes was beneficial, the stigma and negative responses from support and law enforcement personnel were discouraging for survivors. This widespread stigma surrounding sexual violence significantly hinders victims from disclosing their experiences to both formal and informal sources. The distressing stories of survivors facing blame and recrimination are often referred to as "the second rape," which can cause further psychological harm [12].

1.3 Define Opportunity Space

The current system, often reliant on human-to-human interactions, may inadvertently contribute to survivors' hesitation in reporting incidents of sexual assault. Police officers are often the first person a victim comes into contact with when reporting; rapport with the victim can determine whether an interview will fail or succeed. Rapport building during police interviews is limited by the interview technique used and whether the victim feels heard or judged by the police conducting the interview [13]. Traditional interview techniques employed by the police lead to a lack of empathy and often miscommunication, leaving SA victims with feelings of discomfort and, in some cases, feelings of being judged by the police conducting their interviews. Police officers' definitions of sexual assault and perceptions of victim credibility may influence behavior, given the discretion police officers employ in their daily work. Commonly, attitudes of mistrust in women's testimony continue to be evident in police processing of sexual assault cases [14]. Kerstetter and Van Winkle's (1990) study suggests that officers' attitudes and beliefs are communicated to the victim and are experienced negatively [15].

2 Background

2.1 Emotional Support Animals

In addition to the challenges sexual assault survivors face during police interviews, research indicates that emotional support animals (ESAs) can play a crucial role in alleviating stress and creating a more comfortable environment for victims. Studies have shown that animals, particularly dogs, are effective in providing emotional support. Our historic relationship with animals shows that they can play a vital role in emotional well-being, a concept that can extend to using animals for support in legal settings [16]. When it comes to disclosing sexual abuse, especially for children, the process can induce significant stress. Animal-assisted intervention (AAI), with dogs as the primary focus, has emerged as a beneficial approach [17]. Notably, utilizing emotional support dogs in interviews has been shown to help build rapport and contribute to a more positive experience for witnesses and victims [18]. These animals, serving as emotional support during interviews, contribute to a sense of comfort and ease, potentially enhancing the overall communication process between survivors and law enforcement [18].

In the context of sensitive situations such as sexual assault reporting, companion robots offer several distinct advantages over traditional ESAs. Unlike emotional support animals, companion robots do not have feelings or the capacity to make autonomous decisions. This characteristic makes them akin to a *digital shield* for humans, providing a safer and more predictable presence. This predictability ensures that the robot will not inadvertently cause distress or discomfort to the victim. What's more, its non-disruptive

presence provides a more controlled report procedure. ESAs, while beneficial in many scenarios, can sometimes become a distraction due to their natural reaction and senses. Companion robots, on the other hand, are designed to be consistently supportive without the unpredictability of a living animal. Although both companion animals and companion robots are aimed to provide emotional support to victims, the companion robots are designed to handle more complicated situations and tasks without getting accidentally hurt by survivors [19].

2.2 A Digital Shield

How might we better bridge the communication gap between police officers and victims as well as deal with victims' tension, anxiety, and fear during the reporting process? Perhaps it is by providing a *digital shield* between the reporter and the officers, providing some anonymity and reduced intensity. It has been shown that patients dealing with post-traumatic stress disorder (PTSD) report more PTSD symptoms in a live human interaction as compared to a virtual human interaction [20]. In addition, studies using virtual human interviewers in clinical settings suggest interviewees may disclose more readily than with human counterparts [21, 22]. This openness likely stems from perceived anonymity, as interviewees feel more comfortable with sensitive or stigmatized topics. Lucas et al. (2014) and Pickard et al. (2016) found that participants disclosed more when told the virtual interviewer was autonomous compared to being controlled by a human [21, 22]. In essence, the virtual interviewer's "non-humanness" seems to encourage greater candor and potentially reduce anxiety. When told participants would be interacting with a robot rather than a human during a service transaction, participants with greater levels of social anxiety felt less anxiety about interacting with the robot [23, 24].

2.3 Non-judgmental Robots

In addition to virtual interviewers, social robots may provide a *digital shield* that provides active listening without any obvious judgment or bias. Social robots are robots that interact with humans and each other in a socially acceptable fashion, conveying intention in a human-perceptible way, and are empowered to resolve goals with fellow agents, be they human or robot."[24] Social robots have been found to be comfortable [25] or sometimes even a preferred agent compared to humans [26] for disclosing personal information, especially for women [27]. When disclosing stressors, a physically present social robot has been shown to reduce stress compared to virtual robots (via computer or virtual reality) [28]. Some of what may make a social robot

more comfortable during disclosure is its inherent lack of judgment [29]. In this situation, the lower perceived agency of social robots can help victims mitigate the stress and fear of being negatively judged as they remove the human social presence that triggers the perception of social judgment [30]. This imperceptible beneficial characteristic of social robots could make them the preferred disclosure mode over the traditional human-to-human encounter.

2.4 Opportunity Space

Due to the benefit of a digital shield as well as the potential for a social robot disclosure to be comfortable and stress-reducing, social robot agents likely could be designed to play a pivotal yet delicate role in facilitating the reporting process for SA survivors. By acting as digital shields, they offer survivors a non-judgmental and supportive space during interviews, guarding against biases, judgment, and miscommunication that often characterize human-to-human interactions in the context of sexual assault reporting. Addressing these issues requires innovative approaches, and one potential solution is the integration of social robots into police interviews with SA survivors. By providing a safe and non-judgmental environment, social robots have the potential to mitigate the risk of retraumatization and enhance communication between SA survivors and law enforcement.

3 Methods

3.1 Purpose

The research team for this study was formed during a graduate student class studying human-robot interaction at the University of Washington in the Fall of 2023. Each team was assigned pre-existing commercial or prototype robots and a domain (e.g. healthcare, education, security) with which to develop a social robot interaction intended to fulfill a human or societal need. The interaction project had to be prototyped, tested, and completed to work within the 10-week term. Our team was assigned to the Quori robot [31] and the domain of security. We focused on the sensitive issue of sexual assault reporting. Our main Design Questions were as follows:

DQ1. What should an interview robot look like?

DQ2. How can an interview robot reduce the pressure on the discloser?

3.2 Ideation

Given the potential of social robots and the need for a more humane interview and reporting experience for sexual assault (SA) survivors, we began the process by envisioning the background story and use case scenarios for our proposed robot solutions. Through storyboarding and scripting exercises, we imagined a future where a social robot could serve as the first point of contact between law enforcement and survivors of SA, particularly for young adults and minors, who make up a significant portion of reported cases. As a result, the research team decided to focus on the Interaction Robot Assistant platform (IRA).

The role of IRA is to provide a supportive, non-judgmental, and inclusive interaction for survivors to disclose their experiences without the risk of retraumatisation that is associated with traditional in-person interviews. First, we envisioned IRA as a *digital shield* that acts as an intermediary between the survivor and law enforcement, facilitating open communication while protecting the survivor's emotional wellbeing. Next, we formulated a list of potential features and requirements for IRA to be supportive, inclusive, and unbiased toward SA survivors. The team determined that IRA would need a screen for users to interact and communicate with the robot and a camera with recording capability for evidentiary purposes. Depending on each user's preference, IRA must include both verbal and nonverbal communication. The IRA robot would need to communicate with survivors without using inflections, which might convey emotion. The team also wanted IRA to have a large language model (LLM) that would convert police speech or input to trauma-relevant and survivor-supportive speech to avoid retraumatizing the survivors. Finally, IRA would need to be able to communicate in multiple languages so that survivors can speak in their preferred language. Lastly, we documented our design principles to help keep our focus on the experience of SA survivors. We also performed secondary research throughout this project to inform IRA's design and system.

3.3 User Research & Sample

The user research involved three qualitative interviews, one concept testing session with three participants, and one open-house testing session with five participants recruited through convenience sampling from the University of Washington. The interviews were semi-structured and designed to understand participants' preferences for the features the robot should have during the interview and preferences for the robot's voice (male, female, or gender-neutral), facial features (human-like or not), and types of facial

expressions (expressive or flat). The concept testing aimed to understand SA survivors' specific needs, challenges, and preferences during the interview and reporting process with a social robot. User feedback guided iterative refinements to the original design and functionality of IRA, ensuring they met the diverse needs of the target user groups.

3.4 Robots



Fig. 1: Two different robots were used for testing: Quori (left) [31] and Flexi (right) [32].

For the development and implementation of IRA, our prototyping involved two phases: developing both the hardware and software components of the interaction. We used robots and a platform as support.

Quori Robot: is a preexisting social robot with a humanoid upper body capable of locomotion, a limited range of motion in the waist, arms with two adjustable ball joints that mimic the human shoulder, and face projection capabilities [31]. During our first phases, we were assigned the Quori robot to prototype the physical appearance and key features of IRA.

Flexi Robot: Flexi Robot is a customizable social robot featuring two screens: one serving as a "face" and the other as an interactive "body", designed for engaging users in meaningful interactions. Flexi Robot also utilizes a combination of nonverbal and verbal behaviors to engage users. Its nonverbal behaviors include eye gaze, blinking, emotionally expressive animations, head tilting, and leaning backward or forward with its body. Additionally, it employs verbal behaviors such as producing sounds and using natural language expressions to communicate. [32].

EMAR Robot Software: EMAR Robot Software is an integrated development environment that enables programming, control, and customization of social robots like the Flexi Robot used for the IRA platform. It provides backend tools, including a robot API for creating and running programs in JavaScript, as well as frontend tools for administering robot setups, editing facial expressions/animations displayed on the "face" screen, customizing content on the interactive "belly" screen, and a "Wizard of Oz" mode for manually operating robots during interactions [33].

Pup: Pup is a small, portable companion robot with a shell built from a traditional plushy pet toy. Its key feature is to help reduce the interviewee's anxiety through its presence and interactions. It is equipped with sensors for detecting heartbeat and an apparatus that mimics breathing. Pup responds to touch and provides haptic feedback to simulate the presence of a real pet.

3.5 User Testing

Exploring our preliminary concepts and prototypes with actual users was important to better understand the potential needs. We conducted two phases of user testing: low-fidelity concepts and mid-fidelity prototypes. This ensured we could refine and improve the design based on real user input. See Table 1 for an overview of user testing sessions, procedures, and findings.

Table 1: 2 phases testing and detailed interaction with findings.

Phase	<u>Hardware</u>	Interaction Design
Concept Testing (Low Fidelity)	Quori Robot	We designed 6 robot facial expressions for IRA to display its emotional reaction while communicating with users and one user flow for interaction experience. We created paper prototyping for software to collect user feedback on our IRA concept
	<u>Testing</u>	<u>Findings</u>
	University convenience sample (n=3)	User preferences: (1) a stationary robot with minimal movement capabilities (2) users preferred neutral expressions demonstrated by a "robot face" (3) smaller sized robot (4) wanted "to feel heard" (5) some wanted textual and some wanted verbal interactions
User Testing (Mid Fidelity)	Flexi and Pup	We integrated EMAR Robot Software to enable IRA to respond to users with facial expressions and movements[32]. We also developed a clickable, medium- fidelity user interface with Figma so users could experience seamless interaction with IRA.
	<u>Testing</u>	<u>Findings</u>
	University open-house sample (n=5)	 Four users found Pup calming as part of the interaction. Three users thought too much text was offered on screen. Two users thought the interaction buttons were too small. One user suggested animation and verbal interactions. Two users suggested calming messages during the interaction.

3.5.1 Concept Testing - Low Fidelity Testing: Procedure & Findings. After ideating and generating the low-fidelity paper prototype for IRA, the team worked with three university students to test the concept, get feedback on the proposed features, and test the user interaction with the paper prototypes of IRA's screens.

During the testing process, participants were asked to finish tasks, show their interaction with the IRA screens, and then be asked a few questions about their feelings about the interactions, questions focused on gauging their feelings and perceptions about the interactions, including the content presented, the tone and language used, and the robot's facial expressions. The team closely observed their actions and behavior as they navigated through the tasks. Concept testing was conducted in a single classroom with multiple teams at different stations. Our team tested the IRA concept with participants individually. Participants were given a crime reporting scenario where they were instructed that the nature of the crime was sensitive and asked if they would use a robot assistant. If they agreed, they interacted with paper prototypes of the screens while thinking aloud. Post-interaction, participants shared their feelings about the experience, described their envisioned robot, its capabilities, and whether it should have a face and expressions. Finally, they discussed preferred communication methods with the robot during the reporting process.

3.5.2 Findings. During the concept testing interviews, the team found that the users all three users preferred a stationary robot with minimal movement capabilities. They preferred the robot to use neutral expressions demonstrated by a "robot face" instead of a "human face" P1, P2, P3. Two users preferred the robot to be at their eye level, with one saying that if the robot were too large, it "might make the user feel powerless" P3. All three users used their hands to demonstrate the height and width of their ideal robot size. Two of the users pointed to the Flexi Robot in the room and said its size would be perfect. Users also showed interest in the robot being able to provide additional feedback so they felt more heard during the interaction. Users were split when asked if they preferred to interact using text on a screen vs. a spoken interaction with IRA. The screen interaction for IRA was minimal at this stage, though users were interested in the initial offerings of the IRA screens. They said they would like the ability to stop it anytime during the interview and onboarding process. More clarification about whether the user would interact with the robot using speech or screen interaction was needed.

3.5.3 Design Iteration. Based on concept and user testing interviews, we replaced the Quori robot with the Flexi robot. Users found Quori's capabilities intimidating. Flexi was a better fit for the IRA platform, according to the feedback the team received during concept testing. Flexi is stationary with minimal movement; it can tilt its upper "face"

screen, change its facial expression for enhanced user interaction, and has a screen for interacting with that serves as its "body". The Flexi prototype would also be capable of detecting and reading the user's facial expressions to help it better understand what facial expressions it should mimic on its face screen. Additionally, based on the other interview findings, the team added a Pause and Stop button on every screen, enabling users to take a break or quit whenever needed. The team added navigation buttons to each screen for ease of use and introduction screens to explain how IRA is used in the overall interview process and what to expect during the interview. The team also decided to focus on nonverbal communication from IRA as it may improve the reporting experience of sexual assault [29]. Additionally, the team added an Emotional Support Social Robot (ESSR), 'Pup' for the survivors to provide similar support to that of emotional support animals. More details are provided in section 3.5.4.

3.5.4 Design and Integration of Pup. As Darling argues in the book The New Breed, animals, humans, and robots are not meant to replace one another; instead, they complement each other with their unique strengths[16]. Users need unique skills from other species to provide emotional support and instruction on stress release, so we integrated both animals and robots. To mimic the benefits of an emotional support animal, the team designed an ESSR, Pup, which takes the form of a small puppy that fits into the lap of its users, with soft fur to encourage users to hold and touch it, to provide users with comfort through physical touch. Additionally, Pup was fitted with an internal apparatus that would mimic the rhythmic breathing of an Emotional Support Animal to encourage users to adopt its breathing rhythm and potentially reduce sympathetic arousal and promote relaxation [30]. Pup was also enabled with a limited number of physical behaviors like tail wagging and nuzzling to help provide the user with physical comfort when appropriate.

Pup is specifically designed to support the IRA reporting process. Pup can collect valuable physical data from the victim, such as heart rate or skin conductance-related stress levels. This data can be used to adapt the interaction in real time, providing a more personalized and responsive support system. For example, this would enable IRA to take a break if the user's physiological data indicated they were experiencing anxiety or a spike in stress. The additional biological data would also be used with the facial recognition capabilities of IRA to communicate to Pup what the correct reactions are for it to display in real-time. Physiological data would enhance IRA's understanding of what facial expression to display on the upper "face" monitor of the Flexi robot. Additionally, the collected data can assist law enforcement in understanding the victim's emotional state, thereby facilitating a more empathetic and informed response. See Figure 5 for an illustration of the IRA system.

3.6 Mid-fidelity User Testing



Fig. 2: Mid-fi IRA prototype (left) and Mid-fi Pup Robot (right).

3.6.1 Procedure. The team conducted user testing with a mid-fidelity prototype of the IRA interaction. Five participants interacted with IRA and Pup using a hypothetical scenario where they were told that "IRA would serve as the first point of contact between police and survivors of crimes related to sexual assault. Our target demographic is young people 18 years old or younger, as research shows that they make up 67% of people who report SA; in the test scenario, imagine you are a young person wanting to report to IRA. Now, a third-party person like a nurse or counselor will bring IRA to you and log into IRA using their credentials". Users then used IRA while interacting with Pup, and we followed these interactions with a user interview; for the full interaction flow, see Figure 5. The team asked the users for feedback on both robots and any improvements they could make, what the users thought of IRA and its facial features and expressions, and for feedback about the IRA's screens.



Fig. 3: Mid-fi Testing Setup and Process. The participant is holding a Pup to experience breathing mimicry by Pup during interviews (left).

3.6.2 Findings

Four out of five users' interactions with Pup were positive, with one saying that Pup makes her "feel warm and fuzzy, comforting" P2. The users also responded positively to IRA, though there was some confusion when interacting with the screen, prompting the user to select the language they wanted IRA to use during the reporting process. During the interaction, the team found that the tablet was not always responsive and experienced lag when going from one screen to the next, specifically when participants needed to click more on the screen. Also, some users thought the messaging on the screens was too long and the buttons were too small. One user suggested that if IRA and Pup were to be used for a younger user group, the team might want to consider using animation and verbal communication. Additionally, it was suggested that the team add calming or reassuring phrases during the pause part of the interaction, which might help users calm down and feel supported. Examples of such phrases include "It's not your fault," "Just relax," and "Take a deep breath".

3.7 Final Prototype

Using the mid-fidelity user testing feedback, the team decided to iterate on the IRA prototype to use more concise messaging on robot screens. They also changed the

screens to move forward without the user needing to interact with the screen. Still, they kept the backward and forward navigation buttons in case the users wanted to navigate through the screens manually. The team removed buttons from some of the screens and enlarged other buttons. Finally, the team researched and added reassuring statements endorsed by RAINN (Rape, Abuse & Incest National Network) [34] and screens with animated breathing exercises to help calm survivors.



Fig. 4: Final Prototypes of IRA and Pup



Fig. 5: Finite state machine for IRA and Pup interaction with Discloser.

4 Limitations

Due to time constraints and the concern for potentially retraumatizing survivors, we chose not to recruit SA survivors as our test users. However, it would be important to capture the experience and input from actual SA survivors, as well as police officers and other third-party users such as nurses, support counselors, etc., should we proceed with this project. Also, IRA and Pup were tested using limited participants during concept/low-fi and mid-fi testing. Additionally, the interactions tested during the low and mid-fi user testing phases may differ from the higher-fidelity interactions experienced by users interacting with the final prototypes of IRA and Pup. We would work to test the user experience more thoroughly through usability testing. We would comprehensively test all aspects of the on-screen experiences. Finally, we would like to further evaluate users' sentiments toward the expressions displayed on IRA's face screens to enhance the emotional engagement of both IRA and Pup.

5 Conclusion

This paper presents a comprehensive exploration into the design and development of social robots IRA and Pup, guided by a synthesis of user feedback, ideation, concept testing, and mid-fidelity user testing, aiming to transform the landscape of police interviews for survivors of sexual assault.

As we delved into the design and development of social robots IRA and Pup, our research was guided by a synthesis of user feedback, ideation, concept testing, and midfidelity user testing. First, we designed a supportive digital shield. Our ideation phase revealed the necessity for a robot acting as a digital shield, offering support and nonjudgmental space for survivors during police interviews. Users overwhelmingly preferred a stationary robot with minimal movement. This decision is underpinned by the aim to provide comfort and ease and enhance survivors' positive attitudes and confidence during the interview process, recognizing the significance of survivors' emotional well-being. Following victim attitudes from research report data, our approach seeks to contribute to a supportive and empowering experience, aligning with the importance of creating a comforting environment in technology-assisted interventions for survivors of traumatic experiences. We were also focused on iterating IRA's design for user-friendly interaction by migrating the IRA platform from the Quori robot to the Flexi robot. Also, users suggested concise messaging and appropriately sized buttons, non-verbal communication, pause and stop features, a robotic face featuring neutral expressions, system navigation buttons, and creating clear and userfriendly interfaces in technology-assisted interventions. Third, we incorporated an

emotional support social robot, Pup, into our system to provide users with a more emotionally supportive and comforting experience when reporting to the police. By integrating an ESSR, Pup, into the support system, our approach aims to enhance the overall communication process between survivors and law enforcement, aligning with established benefits observed in Spruin's research, highlighting the benefits of ESAs in providing emotional support during stressful situations, and enhancing the overall support system for survivors.

Finally, we address technical and design challenges. Mid-fidelity user testing pinpointed technical challenges such as lag and confusion during interaction. In response, we iterated on IRA's design, enhancing capabilities, including facial expression detection, adding feedback from IRA, calming statements and animations, and changing IRA's facial expressions and Pup's physical behaviors depending on users' data input. Our research process, guided by user feedback and existing literature, culminated in developing IRA and Pup as transformative tools to mitigate retraumatization, enhance communication, and foster a more supportive environment during police interviews. By synthesizing our findings with established knowledge in the field, we present a holistic approach to addressing the challenges faced by survivors of sexual assault within the criminal justice system.

In our design concept, IRA possesses the capability to interact with users through body language and facial expressions. The next step in development would be enhancing the prototyping of the design; this prototype will encompass the integration of emotion recognition, allowing us to visualize and refine the interactive elements. By evaluating and comparing these interaction types, we aim to identify the most impactful and user-friendly approach for IRA's and Pup's multi-modal interactions, ensuring a compelling and inclusive user experience.

Considering these findings, integrating social robots into police interviews deserves further investigation for adult survivors and children who may face additional challenges articulating their experiences. This combined strategy may harness the strengths of technology, empathy from social robots, and the comforting presence of emotional support social robots to offer a more empathetic and effective approach to supporting vulnerable individuals through the difficult process of disclosure and investigation. This holistic perspective underscores the potential transformative impact that these innovative technologies can have on various facets of support and care for survivors of sexual assault.

CRediT Author Statement. Cryston Sahae: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Resources, Writing-Original Draft, Writing-Review and Editing, Visualization, Supervision, Project Administration.

Shuyue Gu: Methodology, Visualization, Software, Formal Analysis, Investigation, Resources, Writing-Original Draft, Writing-Review and Editing. Lige Yang: Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Writing-Original Draft, Writing-Review and Editing. Elin Björling: Supervision, Writing-Original Draft, Writing-Review and Editing. Nichelle Song: Conceptualization, Methodology, Validation, Formal Analysis, and Investigation.

References

- Chivers-Wilson K. A.: Sexual Assault and Posttraumatic Stress Disorder: A Review of the Biological, Psychological and Sociological Factors and Treatments, *McGill Journal of Medicine*, vol. 9, no. 2 (2020) doi:10.26443/mjm.v9i2.663.
- Holly J.: Why Doesn't She Just Report It?: Apprehensions and Contradictions for Women Who Report Sexual Violence to the Police, Canadian Journal of Women and the Law 29, no. 1, pp. 36–59 (2017) doi:10.3138/cjwl.29.1.36.
- Snyder H. N.: Ph.D. (n.d.). Sexual assault of young children as reported to law enforcement: Victim, incident, and offender characteristics. Sexual Assault of Young Children as Reported to Law Enforcement: Victim, Incident, and Offender Characteristics | Office of Justice Programs. <u>https://www.ojp.gov/ncjrs/virtual-library/abstracts/sexual-assault-youngchildren-reported-law-enforcement-victim</u>
- 4. Cantor D. et al.: Report on the AAU Campus Climate Survey on Sexual Assault and Misconduct (2019)
- 5. Morgan R. et al.: Criminal Victimization, 2019 (2020)
- Monroe L., Kinney L., Weist M., Dafeamekpor D., Dantzler J., Reynolds M.: The experience of sexual assault: findings from a statewide victim needs assessment, Journal of Interpersonal Violence, 20(7), pp. 767–776 (2005) https://doi.org/10.1177/0886260505277100
- Lorenz K. et al.: I Was Worried I Wouldn't Be Believed: Sexual Assault Victims' Perceptions of the Police in the Decision to Not Report, Violence and Victims, vol. 36, no. 3, pp. 455– 476 (2021) <u>https://doi.org/10.1891/vv-d-20-00058</u>. Accessed 26 July 2021.
- Jacques-Tiura A. J., Tkatch R., Abbey A., Wegner R.: Disclosure of sexual assault: characteristics and implications for posttraumatic stress symptoms among African American and Caucasian survivors, Journal of Trauma & Dissociation, 11(2), pp. 174–192 (2010) https://doi.org/10.1080/15299730903502938
- Webster WS, Oxburgh GE: Victims of sexual offences: aspects impacting on participation, cooperation and engagement with the interview process. Psychiatr Psychol Law (2021) 17;29(5):679-697. doi: 10.1080/13218719.2021.1956387. PMID: 36148386; PMCID: PMC9487919.
- Venema R. M.: Police Officer Schema of Sexual Assault Reports: Real Rape, Ambiguous Cases, and False Reports. Journal of Interpersonal Violence, 31(5), pp. 872-899 (2016) <u>https://doi.org/10.1177/0886260514556765</u>

- 11. Kerstetter W. A. and Van Winkle B.: Who decides?, *Criminal Justice and Behavior*, vol. 17, no. 3, pp. 268–283 (1990) https://doi.org/10.1177/0093854890017003003.
- 12. Darling K.: The New Breed: What Our History with Animals Reveals about Our Future with Robots. Henry Holt and Company (2022)
- Krause-Parello C.A., Thames M., Ray C.M., Kolassa J.: Examining the effects of a service trained facility dog on stress in children undergoing forensic interview for allegations of child sexual abuse, Journal of Child Sexual Abuse 22(3) pp. 305-320 (2018) <u>https://doi.org/10.1080/10538712.2018.1443303</u>
- Spruin E., Dempster T., Mozova K.: Facility dogs as a tool for building rapport and credibility with child witnesses, International Journal of Law, Crime and Justice 62: pp. 1-12 (2020) <u>https://doi.org/10.1016/j.ijlcj.2020.100407</u>
- McDonald S.: Helping Victims Find their Voice: Testimonial Aids in Criminal Proceedings. Victims of Crime Research Digest, No. 11, at 5-13. Ottawa: Department of Justice Canada. (2018)
- Kothgassner O.D. et al: Virtual reality exposure therapy for posttraumatic stress disorder (PTSD): A meta-analysis, *European Journal of Psychotraumatology*, vol. 10, no. 1 (2019) <u>https://doi.org/10.1080/20008198.2019.1654782</u>.
- Lucas G. M., Gratch J., King A., Morency L. P.: It's only a computer: virtual humans increase willingness to disclose, Comput. Human Behav. 37, pp. 94–100 (2014) <u>https://doi.org/10.1016/j.chb.2014.04.043</u>
- Pickard M. D., Roster C. A., Chen, Y.: Revealing sensitive information in personal interviews: is self-disclosure easier with humans or avatars and under what conditions?, Comput. Human Behav. 65, pp. 23–30 (2016) https://doi.org/10.1016/j.chb.2016.08.004
- Laban G., Ben-Zion Z., Cross, E. S.: Social robots for supporting post-traumatic stress disorder diagnosis and treatment. Frontiers in Psychiatry, 12 (2022) <u>https://doi.org/10.3389/fpsyt.2021.752874</u>
- 20. Social Robot. Social Robot an Overview / ScienceDirect Topics, www.sciencedirect.com/topics/computer-science/socialrobot#:~:text=Computer%20Interaction%2C%202017-,Social%20Robots,et%20al.%2C%201999). Accessed 30 Jan. 2024.
- 21. Hoffman G., et al.: Robot responsiveness to human disclosure affects social impression and appeal, *Proceedings of the 2014 ACM/IEEE International Conference on Human-Robot Interaction* (2014) <u>https://doi.org/10.1145/2559636.2559660</u>.
- 22. Luo R. L. et al.: Social robots outdo the not-so-social media for self-disclosure: Safe machines preferred to unsafe humans?, Robotics, vol. 11, no. 5, p. 92 (2022) https://doi.org/10.3390/robotics11050092.
- Uchida T. et al.: Japanese young women did not discriminate between robots and humans as listeners for their self-disclosure -pilot study-, *Multimodal Technologies and Interaction*, vol. 4, no. 3, p. 35 (2020) <u>https://doi.org/10.3390/mti4030035.</u>

- Björling E. A., Ling H., Bhatia S., Matarrese, J.: Sharing stressors with a social robot prototype: What embodiment do adolescents prefer?, International Journal of Child-Computer Interaction, 28, 100252 (2021) <u>https://doi.org/10.1016/j.ijcci.2021.100252</u>
- Holthöwer J., van Doorn J.: Robots do not judge: service robots can alleviate embarrassment in service encounters, Journal of the Academy of Marketing Science, 51(4), pp. 767-784 (2023) <u>https://doi.org/10.1007/s11747-022-00862-x</u>
- 26. Pitardi V., et al.: Service Robots, Agency and Embarrassing Service Encounters, Journal of Service Management, vol. 33, no. 2 (2021) <u>https://doi.org/10.1108/josm-12-2020-0435</u>.
- 27. Quori, <u>www.quori.org/#index</u>. Accessed 25 Jan. 2024.
- 28. Alves-Oliveira P. et al.: Flexi: A robust and flexible social robot embodiment kit, Designing Interactive Systems Conference (2022) <u>https://doi.org/10.1145/3532106.3533541</u>.
- Harling G. et al.: Nonverbal response cards reduce socially desirable reporting of violence among adolescents in rural Burkina Faso: A randomized controlled trial, *Journal of Adolescent Health*, vol. 68, no. 5, pp. 914–921 (2021) https://doi.org/10.1016/j.jadohealth.2020.09.006.
- Busch V. et al.: The effect of deep and slow breathing on pain perception, autonomic activity, and mood processing—an experimental study, Pain Medicine, vol. 13, no. 2, pp. 215–228 (2012) <u>https://doi.org/10.1111/j.1526-4637.2011.01243.x.</u>
- 31. Issue 2, February 2012, Pages 215–228, https://doi.org/10.1111/j.1526-4637.2011.01243.x
- 32. Alves-Oliveira P. et al.: Flexi: A robust and flexible social robot embodiment kit, Designing Interactive Systems Conference (2022) https://doi.org/10.1145/3532106.3533541.
- 33. Emar Robot Software Tools. EMAR Robot Frontend Tools, mayacakmak.github.io/emarsoftware/. Accessed 22 May 2024.
- Tips for Talking with Survivors of Sexual Assault. RAINN, www.rainn.org/articles/tipstalking-survivors-sexualassault#:~:text=%E2%80%9CI'm%20sorry%20this%20happened,%2C%E2%80%9D%20h elp%20to%20communicate%20empathy. Accessed 22 May 2024.