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EXPLORING LAW ENFORCEMENT OFFICERS' EXPECTATIONS AND ATTITUDES ABOUT COMMUNICATION ROBOTS IN POLICE WORK

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Abstract: *This study explores the perspectives of law enforcement officers (LEOs) on the implementation of communication robots in police work. Through two approaches - open-ended questionnaires (N = 37) and focus group discussions (N = 14) - the research aims to gather LEOs' opinions and attitudes on the potential future use of these robots. The findings reveal a general skepticism among LEOs, who express low trust in communication robots. Despite this, a majority acknowledge that robots could enhance communication effectiveness in policing. The study highlights the need for increased public education and enhanced performance accuracy of robots to address LEOs' concerns and foster greater acceptance of this technology in law enforcement.*

Keywords: *robot, communication, law enforcement, police.*

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INTRODUCTION

The use of robots in law enforcement has been a long-debated topic among scholars and the public. Some scholars have argued in favor of using robots in law enforcement as robots have proven to be suitable replacements for law enforcement officers (LEOs) in risky situations. Therefore, they hold a great promise to maintain the safety and security of both civilians and LEOs (Murphy, 2004). Alternatively, other researchers have opposed employing robots in law enforcement, arguing that robots used in law enforcement raise ethical and legal questions and concerns. Therefore, the current study aimed to analyze the different perspectives LEOs have on using robots in law enforcement. To obtain these perspectives, the project introduced a novel communication robot design to LEOs and explored their sentiments regarding factors such as communication, trust, and their attitudes towards this type of technology. This endeavor also allowed for the consideration of relevant ethical and legal considerations of the study participants.

Robots have been designed to be used in a variety of situations in the law enforcement context. Most commonly, robots were used for dangerous situations such as hostage, security, and surveillance (Karthikeyan et al., 2015; Matthies et al., 2002; Patel et al., 2013; Zheng, 2019). Additionally, they were designed for bomb searching and disposal (Day et al., 2008; Motaleb et al., 2016; Zeng et al., 2007). During mundane tasks, robots can be implemented in traffic control in replacement of human traffic police (Gong et al., 2017). They can also be used for object recognition, searching, and detection (Flann et al., 2002). Moreover, robots could be of great assistance in unexpected circumstances, such as serving as a medic during the COVID-19 pandemic (Javaid et al., 2020; Sahu et al., 2022), as well as in disaster rescues (Nath, Arun, & Niyogi, 2019). This study explores additional scenarios in which communication robots can be implemented.

However, to accomplish a task by a human-robot team, humans must trust in the robot teammate and believe that the robot will protect the interests and well-being of each individual on the team (Hancock et al., 2011). The human trust level in the robot partner will be critical in high-risk situations, such as combat missions (Chen et al., 2008; Chanel et al., 2020), or when a human's life is at risk - such as a suicidal situation (Rastogi et al., 2018). Trust is of pivotal importance in human-robot interaction (HRI) as it significantly affects the willingness of people to accept robot-produced information or follow a robot's suggestions and ultimately benefit from the advantages of the robot's presence in the system (Freedy et al., 2007). Trust also influences the decisions humans make in uncertain environments where they partner with robots (Park et al., 2008). Accordingly, as law enforcement consists of numerous high-risk decision-making situations, trust is one of the cornerstones of the HRI in this profession. The level of trust in robots in HRI varies in the range of very low to very high, which both may have an adversary effect. In the case of excessive high trust, overreliance on and misuse of the system occurs, or in the case of low trust, disuse of the entire system may happen (Lee & See, 2004; Parasuraman & Manzey, 2010; Parasuraman & Riley, 1997). As a result, distrust and overreliance can deteriorate the efficiency of the HRI.

Nonetheless, recent studies have demonstrated that LEOs generally have a high level of trust after obtaining training using law enforcement communication robot platforms (Bordbar, Salehzadeh, Cousin, Griffin, & Jalili, 2021). Training with communication robots led to a reduction of LEOs' initial negative attitude toward the robot. It resulted in high

general levels of trust in their interactions with communication robots when LEOs completed the training (Bordbar et al., 2021). Therefore, in the current study, LEOs' trust levels were investigated further to explore the conditions that may result in excessively high or low levels of trust, i.e., what factors lead to high or low levels of trust towards a communication robot. The goal of exploring these factors is to enable future researchers or police training to adjust to these factors so that higher trust levels can be appropriately obtained from LEO communication robot operators.

Trust in robots, robot acceptance, and attitudes towards robots are also influenced by other factors, including human-related and robot-related factors. Human-related factors are associated with either human abilities or human characteristics. Human abilities include attention capacity/engagement, expertise (Navarro et al., 2021), competency, operator workload, previous experience, and situation awareness. Human characteristics refer to demographics, personality traits, attitudes toward robots, comfort with robots, self-confidence, and propensity to trust (Hancock et al., 2011). Additionally, culture is a significant human-related factor that impacts robot acceptance. Several studies in the past have shown that cultural differences affect one's attitude toward robots (Bartneck et al., 2005; Bartneck et al., 2005; Huerta et al., 2012). This is primarily due to different extents of exposure to robots through media or personal experiences among cultures. Demographic differences such as age and gender impact trust and acceptance in robots (Hoff & Bashir, 2015). Self-efficacy perceptions or self-beliefs is another human-related factor that affects the acceptance of new technologies.

The concept of self-efficacy in robot acceptance has been studied in the field of both social robots (e.g., humanoid, pet, service robots) (Latikka, Turja, & Oksanen, 2019) and non-social robots (e.g., collaborative robots) (Bröhl et al., 2019). Overall, due to the significance of all the above-mentioned human factors in robot acceptance and trust, robots could be considered a help or hindrance in society. In the context of law enforcement, the general attitude toward robots could be both positive and negative (Yunus & Doore, 2021; Szocik & Abylkasymova, 2021). Robots have gained increased traction to be used as a tool to augment and replace required functions by LEOs. Robots could benefit LEOs in some situations, such as explosive ordinance disposal or surveillance, since using robots provides safer alternatives to direct human activities (Murphy, 2004; Theodoridis & Hu, 2012). However, many scholars have raised concerns about the consequences, particularly if robots are allowed to use force, make decisions, and act autonomously (Asaro, 2016; Howard & Borenstein, 2018). Furthermore, the lack of transparency and accountability in robotics has been discussed (Royakkers & van Est, 2015). Moreover, many LEOs are still reluctant to adopt robotics into their day-to-day operations because of the robots' complexity, cost, the burden of use, and other limiting factors. It is safe to conclude that robots could have a significant impact on law enforcement in the future. Nevertheless, using robots as a tool in law enforcement will face major challenges due to the complexity of the social and physical space in the public domain (Salvini et al., 2010).

However, for the robot that is supposed to be used as a communication medium, the communication function of a robot is also crucial when operating in the field. Robots' communication abilities should be developed to build relationships empathy, and trust in human-robot interaction. Miscommunication or ineffective communication could lead to severe consequences. Back in the 1990s, robots were starting to develop communication

abilities that involved following and responding to simple, pre-programmed commands. However, they were not able to process and initiate emotional speeches and were not able to communicate nonverbally (Mavridis, 2015). As such, natural language and speech planning in robots-human communication are needed, especially when communicating with non-experts (Mavridis, 2015) such as civilians. Past research has tried to enhance robot communication abilities as well as prevent communication interference. For instance, Brooks et al. (2012) employed a natural and continuous language system during communication between robots and operators to acquire accurate commands during tasks. Furthermore, technologies were developed to prevent hacking and enhance hacking detection in robot communications (Abeykoon & Feng, 2017). Efforts were also made to enhance communication abilities and communication links between robots and the operators when the link becomes low such as inside a building (Nguyen, Farrington, & Pezeshkian, 2004). In addition, abilities to pick up non-verbal cues and respond to natural nonverbal behaviors were researched (Vogeley & Bente, 2010). In the revolutionary world, social robots have emerged as a unique category. These robots are specifically designed with social-communicative functions to interact with humans as communicative entities (Gasser, 2021).

With taking all above mentioned into account, this study uses a conductive method, hoping to get a clear and comprehensive understanding of LEOs' opinions towards using robots in law enforcement. The selected work domain was law enforcement, and our selected workers were LEOs. The selected workplace was the daily face-to-face interactions between LEOs and civilians. Directed by past research and the existing gaps, there are three main aims of this study: 1) to understand police officer's attitudes towards communication robots, 2) to introduce critical factors affecting the acceptance of the communication robot in the law enforcement context, 3) to discover the barriers for further development of communication robot in law enforcement.

METHOD

Study Design

This study is a part of a larger mixed-method study that involved survey collections. The two parts discussed in this study include open-ended responses from LEOs' training sessions and two focus group sessions. The training sessions took place in several locations that involved LEOs participating in eight-hour training sessions consisting of topics in communication (i.e., nonverbal, intercultural, mediated) and robotics (i.e., robots' application, robots' functionalities, robotic technologies). In Study 1, participants underwent training sessions focused on communication and robotics. During these sessions, they had the opportunity to operate prototype communication robots. The prototype features a wheeled robot that can be controlled via game controllers, equipped with a manipulator, a microphone, a stereo camera, a 3D camera, a touchscreen display, and a Pan servo (See Figure 1). As LEOs operate the robot, they can simultaneously see, hear, and communicate with the recipient. Additionally, the robot is equipped with a mapping function that can provide a map of the target building before LEOs enter it. The overarching goal of this larger project is to assess whether these trainings and robot operations influence LEOs' attitudes and acceptance of robot usage in law

enforcement, as well as to gather feedback that could inform the improvement of robot design. For the purposes of this paper, the data analyzed are from the pretest responses, collected before LEOs had any experience with the communication robot. Their only exposure to the robot was its presence on display, allowing them to observe it and form preliminary impressions of its capabilities. The focus groups in Study 2 were conducted via Zoom with LEOs with various levels of experience to gather their responses and opinions regarding employing robots in law enforcement. These participants did not receive any trainings nor interacted with the robot prototypes.

Figure 1. Communication Robot Prototype

Study 1 (Curriculum/Training)

Participants

A total number of N = 54 sworn LEOs with different years of field experience participated in the communication training sessions and training with the robot prototype. The responses from N = 37 officers who have completed all the surveys were considered in this study. The LEOs of various ranks (e.g., police officer, deputy sheriff, investigator, chief, captain) were recruited from four law enforcement agencies in the State of Alabama. Most participants were male (89.2% male, 8.1% and 2.7% not reported) and the average age of the participants was 40.2 years (n = 37, M = 40.2, SD = 13.38). The average years of experience of the participants were 17.03 (n = 37, M= 17.03, SD= 11.04). The education level of the participants was recorded as high school degree or equivalent (5.6%), some college/no degree

(36.1 %), associate degree (13.9%), bachelor's degree (30.6%), master's degree (11.1%), and doctorate or professional degree (2.8%).

Procedure

For the recruitment process, an email attached with a copy of the informed consent form (for participants' prior review), was sent to senior officers, police executives, supervisors, and/or appropriate personnel at the City of Tuscaloosa Police Department (TPD), the Center for Best Practices in Law Enforcement at Jacksonville State University (JSU), and the Alabama Peace Officer's Standards and Training Commission (APOSTC) Law Enforcement Academy – Tuscaloosa (LEAT) who work with police officers in training, or requiring continuing education hours. In that email, the scope of research and the project aim was explained. It was mentioned that researchers at The University of Alabama were investigating the effects of robots on the future of law enforcement. The project aims described as developing a highly interactive, remotely operated robotic platform to equip law enforcement officers with the ability to remotely communicate and interact with various individuals for purposes including collaboration or assistance. Also, it was mentioned that officers would operate robot prototypes and provide feedback.

Participants in the study were involved on-site at either the City of Tuscaloosa Police Department (TPD), the Center for Best Practices in Law Enforcement at Jacksonville State University (JSU), or the Alabama Peace Officer's Standards and Training Commission (APOSTC) Law Enforcement Academy –Tuscaloosa (LEAT). Four sessions were conducted in total, two sessions at the Center for Best Practices in Law Enforcement at Jacksonville State University (JSU), and one in each of the other departments. No compensation was provided to individuals for participating in this research study. There were no direct benefits to participants aside from obtaining hands-on experience piloting a social robot and learning about the topics of nonverbal and intercultural communication. The topics were specifically selected in agreement with the agencies' administrators and counted towards officers' required continuing education hours.

The study consisted of an 8-hour (8:00 am –5:00 pm) day of training and testing. These days were divided into two sessions: 1) Communication training and 2) robot testing and piloting. In the communication sessions, officers were provided with training on topics related to nonverbal communication (e.g., facial expressions & emotion, paralanguage & deception) and intercultural communication (defining culture, dimensions of culture, research on differences across cultures & police), computer-mediated communication (CMC), effective communication, and robotic-mediated communication & police work intended to improve awareness and skills of officers on these topics. Officers also participated in a cross-group threats exercise. In the robotics session, first, our research group provided training on topics related to robot design, robot interface, robot communication channels, and robot behaviors. Also, there was a discussion on the future of robots in police work and how robots are expected to be used as a tool in the future to help officers. In the end, officers worked alongside robotics trainers to pilot, control, and navigate a robot through a simulated scenario(s) and provided us with their feedback. The entire day of training and testing was designed to satisfy the required continuing education hours. During both sessions, officers actively participated in discussions, received training, and filled out surveys.

Table 1. Study 1 Coded Themes

Themes	Category	Codes
Scenarios	• Human-created situation • Non-human created situation	• Bomb • Hostage • Search and detection (e.g., collect information, map, search, detect danger, detect criminals) • Tactical • Mediation • Officer safety & protection • SWAT • Active shooting • Public safety (e.g., save life, buy time) • Delivery/removal/moving • Neutralizing capability • Routine activities (e.g., parking tickets, tag/license scan, traffic control, identification) • live medical assistance • Force multiplier • In stressful/threat situations • Negotiation (other than hostage) • First response (fire/rescue/ emergency medical technicians) • Natural disasters • Hazardous scenes
Trust	• Low trust • High trust	• Failure during operation • Human-robot communication is not as effective as human-human communication (loss of interpersonal contact, attention, touch) • Financial risk if the robot fails • Fear of robots/anxiety • A robot is less threatening than a police officer • No risk in using robots • The safest way to use a robot
Attitude	• Positive (help) • Negative (hindrance) • Both (what is needed/challenges)	• Force multiplier • Alleviate the possibility of perceived immediate danger • Greater capabilities and features than the human (can be our eyes and ears when needed, no emotions, no bias) • More advanced and accepted in future • Reliance of LEOs on the assistance of robots (over dependency on robots) • Inability to have human senses • Robots are not practical in every situation/risky to use robot • Training in robotics might be expensive • Ethics • Emotional adverse effect, rapport • Education/training • Situation dependent • Budget needed/funding • More robot/increasing the number • Willingness/ familiarity/ feeling comfortable • Administration/permission/ regulation
Communication	• Better communication • Worse communication	• Safer communication (direct communication is not safe) • Open/effective communication • Communication with suspects, victims, and disabled people • Effective communication with disabled people • Translation & interpretation (communicate in various languages) • The communication is difficult by robot

Study 2 (Focus Group)

Participants

The focus-group study was performed in two sessions. In the first session, six male police officers (N = 6) participated, whose expertise was in different policing areas, including safety, emergency management, teaching criminal justice investigations in domestic terrorism and violent crimes, and law enforcement academy. These participants were recruited from Jacksonville State University, Jacksonville Police Department, APOSTC Law Enforcement Academy in Tuscaloosa, and Flathead Valley Community College. The positions of these participants were director (n = 4), officer (n = 1), chief (n = 1). The participants had a range of job experience from 16-37 years (n = 5, M = 27.4, SD = 7.55).

In the second session of the focus group, eight male police officers (N = 8) participated who have worked in different scopes of law enforcement, including patrol, homicide unit, threat assessment, law enforcement academy, bomb tech, crime center, narcotic, robot, and drone units. These participants were recruited from Tuscaloosa Police Department, Oxford Police Department, and Jacksonville State University. The rank of these LEOs were sergeant (n = 5), investigator (n = 2), lieutenant (n = 1). The range of job experience of the participants was from 4.5-23 years (n =7, M = 16.29, SD = 5.54).

Procedure

Two focus groups were conducted with two law enforcement populations. Due to COVID-19 restrictions, both focus groups were conducted online via the Zoom platform. The time duration of both meetings was 90 minutes.

A criminal justice professor who specialized in international crime prevention acted as the moderator for both focus group sessions. Using the experience and connection of the criminal justice professor, the research team utilized a convenience sampling method and, consequently snowball sampling techniques to recruit participants for both focus groups. LEOs' consent was obtained online via the DocuSign application before the focus group meetings. Other research team members who participated in the zoom call were a communication professor specializing in nonverbal communication and a mechanical engineering professor specializing in robotics. These two professors assisted the moderator with questions from their respective disciplines. The zoom call was designed to be confidential, and only the audio recording in progress was preserved.

The outline of both focus groups was as the following: the first 10-15 minutes were spent explaining to the participants and reviewing the confidentiality and audio-only features of the sessions. Participants' names were removed from the screen labels and instead were replaced with their ranks when speaking to maintain their anonymity. Next, the moderator explained the project and the conceptualization of communication robots to the participants.

Data Analysis

In both studies, thematic analysis was employed as the primary analysis method (Bulmer, 1979). Thematic analysis is a flexible and accessible technique that is well-suited for

identifying, analyzing, and reporting patterns within data. It can be adapted to various research questions, data types, and theoretical frameworks, making it particularly suitable for our interdisciplinary research team (Braun & Clarke, 2006). The method's ease of application allows researchers with varying levels of experience to explore the depth and complexity of their data, providing rich insights into participants' experiences and the social context. Thematic analysis also facilitates the comparison of themes across different data sets, which is valuable in studies involving multiple groups or sites (Guest, MacQueen, & Namey, 2012). Moreover, its systematic and transparent approach enhances the credibility and trustworthiness of the research findings (Nowell, Norris, White, & Moules, 2017).

The pretest qualitative dataset obtained from pretest-posttest surveys was used to generate the list of codes. The code generation was done in a team-based approach. Group meetings were held to generate general themes. Then, team members individually worked on the data and generated their codes. At the next step, several meetings were conducted to discuss the codes, and finally, based on all team members' agreement, the codes were combined, and the code book was finalized.

Transcripts from the two focus groups were redacted and cleaned up by two team members. A draft code book was then developed among the first four authors that contained main themes and categories. Then, each author individually coded one of the transcripts and met with another team member to discuss the codes and reach agreements on the codes. Next, all four authors met and discussed both transcripts and cross-examined the codes. Codes were combined and finalized after group discussion and cross-examination.

Table 2. Study 2 Coded Themes

Themes	Category	Code

Situations/scenarios to use robots	• Serious/dangerous situation
	• Non-serious/non-life threating situation
	• De-escalate situations & prevention
		• Bomb squad
		• hostage situation/mental illness/barricaded man
		• Active shooting
		• Surveillance/security Check
		• Detention/jails
		• Parking areas
		  • De-escalate
		  • Prevent dangerous/ safety

Trust in robots	• High • Low • Depending	• Already in use • Lose robot/money but save people • Skeptical • Taking away the rapport • Situation dependent
Acceptance/attitudes towards robots	• Positive • Negative • Depending (challenges for implementation)	• Capabilities beyond human abilities • Build rapport • More presence-exposure-acceptance • Preference for human/against robot • Intimidating • Lack of budget • Affordable cost • Training of officers • Robot accuracy • Education of the public • Community outreach and influencers
Communication	• Better communication	• Providing more communication abilities/ communicate more effectively • Report/provide more information • Negotiation

RESULTS

Scenarios Study 1

When asked about what situations robots can be used in law enforcement, LEOs identified a variety of human-created or human-related situations and/or scenarios. Among the several highly mentioned scenarios, the search and detection task were the most frequently reported theme, which includes information collection, mapping, searching, detecting dangers, detecting criminals, navigating, and surveillance—followed by first response scenarios that include fire, rescue, and emergency medical technicians (EMT). Additionally, the responses indicated robots could be used for keeping officers safe and providing protection, as well as prompt public safety that it could save lives and buy more time in such dangerous situations. Although many LEOs reported robots could be used in generally stressful or threatening situations, two specific dangerous scenarios were highly mentioned in the responses: bomb and hostage. In addition, SWAT and active shooting were also salient themes in the responses. Besides the dangerous situations, non-threatening routine activities were also one of the major themes that emerged from the responses. In specific, LEOs reported robots could be used for giving parking tickets, doing tag or license scans, assisting neighborhood patrol and traffic control, and identifying people. Similarly, robots can be used for any delivery or object removal tasks, as well as EOD tasks. Overall, robots can act as force multipliers to LEOs as they are learning and busy with multiple tasks. LEOs further identified non-human created or accidental situations such as natural disasters and hazardous scenes.

Scenarios Study 2

In the focus group, LEOs discussed various scenarios robots could be used in law enforcement. Many of them mentioned hazardous situations such as hostage situations, mental illness-related situations, and barricaded man situations. Others discussed the use of bomb squads and active shooting scenarios.

Other than serious situations, LEOs also emphasized the use of non-serious or life-threatening mundane scenarios. For instance, robots can be used for surveillance and security check. Moreover, LEOs specifically mentioned the use of robots in detentions and jails. For instance, providing medications to inmates. Lastly, some LEOs discussed the use of robots in parking areas as they can assist in parking and parking tickets.

The last theme that emerged from the focus group study was the use of robots for de-escalation and crime prevention. LEOs believed robots can assist in detecting dangers before anything bad happens so that they can provide prevention abilities.

Trust Study 1

The effect of trust in the functionality of the robot was investigated at two levels of high trust and low trust, based on the LEOs' responses to the questions of this survey. In this regard, the most critical keyword and basically the main concern of the LEOs in the investigation of trust was the failure of the robot during operation. Most of the LEOs showed their skepticism in trusting robots by accentuating the point that the robot may fail during the operation. It was

mentioned that this failure could happen due to the susceptibility of the robot, inability to view a scene thoroughly, and malfunction of the wireless transmission and sensors. Additionally, one LEO raised a concern about the potential danger of the robots that they can be hacked and used against LEOs. In addition to this concern, a few officers noted possible financial risk if the robot fails and the fear and anxiety that the robot can cause are the reasons not to trust the robots during the operation.

However, LEOs' trust in the robot during the operation was also expressed. These LEOs' were of the belief that using the robots cannot pose a potential danger, the robot is less threatening than police officers, and there is no risk in using the robot; hence they trust the robot in law enforcement.

Trust Study 2

In the focus group study, LEOs were asked to share their opinion about trust in using robots for communication purposes in law enforcement and what would be the public's reaction if LEOs use the robot more communicatively. Thus, besides the low and high levels of trust, situation-dependent trust is also examined based on the LEOs' responses. LEOs expressed their high level of trust by emphasizing that losing the robot will cause financial loss, but it can save people. Also, LEOs who have worked with robots in law enforcement or have known robots are already in use for policing tasks demonstrated a high level of trust in the communication robot.

On the opposite side, which includes the majority of LEOs' opinions regarding trust, LEOs believed that using robots takes the rapport away from human interactions. Also, LEOs were skeptical of the function of robots in law enforcement, and in this way, they expressed their low level of trust in the robots in law enforcement.

On the contrary, some of the LEOs mentioned that trust in robots depends on the situation. In some situations, the robot can be available to provide more information. In others, the robot may degrade the rapport and create distrust and hence make the situation worse.

Attitude Study 1

In study 1, to assess LEOs' attitudes toward robots, they were asked the following questions: Do you think that robots would be more of a help or hindrance in police work? Why? LEOS had different responses to these questions. The responses have been divided into three categories, positive (i.e., help), negative (hindrance), and both.

LEOs mentioned four kinds of referrals. First, LEOs emphasized that robots have greater capabilities and features than humans. In other words, according to the LEOs, robots can be our eyes and ears when needed, with no emotions, and no bias. Since robots are not emotional, they can mitigate the chances of human emotions getting out of control. Also, robots do not need breaks, they don't get tired, and their situational awareness isn't compromised by the emotions that an officer might be carrying around. Second, LEOs mentioned that robots alleviate the possibility of perceived immediate danger by officers. Robots can limit risks to human officers; they can go where it is not safe for officers; and in some situations, they could take the danger element down when there is a high risk of death

for human. Third, LEOs believed that robots could be a force multiplier in law enforcement in a way that robots could supply options and could even de-escalate a situation. Robots could handle the report and recording of the incident much more accurately, they can be placed in uncertain positions (s) to notify or bring awareness, and they could rapidly process routine tasks. In general, robots can help with different aspects of the job. Fourth, LEOs explained that because of the recent advancements in various technologies such as robotics and artificial intelligence, people would be more adoptive respect to those technologies in the future, so this will make robots to be more accepted in the future by LEOs and by society.

Among LEOs that believed robots would be more of a hindrance in law enforcement and the majority of them have mentioned the emotional adverse effect as their reason. LEOs believed that using robots would result in losing interpersonal one-on-one connections and interactions. Human-human communication is more efficient, and some people feel more comfortable communicating with a human rather than a robot. It has been mentioned by several of the LEOs that robots might not be practical in every situation, and this is a hindering factor in using robots. In addition, it was believed among several LEOs that training on robots is an expensive process that could create a barrier to adopting robots by law enforcement.

The majority of LEOs discussed that robots in law enforcement could be both of help and a hindrance, and it completely depends on the situation the robot is used. LEOs considered robots as a tool that must be maintained and used in the right circumstances and their help or hindrances depend on the situations that they are facing. Moreover, since Robots are tools, there are some limitations in their applications and LEOs should be trained regarding both technical limitations and advantages. It has been mentioned by LEOs that quick response time is a characteristic that makes use of robots more of help and could assist in facilitating specific duties of LEOs; otherwise, the robot will be more of a hindrance. LEOs described the challenges that made using the robot in law enforcement a hindrance and mentioned what is needed to tackle these challenges. Several mentioned education and training about robots as a step that needs to be taken. In addition to training, financial issues were considered a barrier to adopting robots in law enforcement. Law enforcement departments need to have access to available funding to be able to purchase this type of equipment. At the same time, it is necessary to offer lower price options for robots for smaller departments. LEOs also pointed out the public might not like interacting with a robot which decreases the robot's effectiveness in law enforcement. Therefore, it is important to familiarize society with this type of technology because in that case, both LEOs and the public will feel comfortable working with robots and trust robots. They also suggested that training children at schools would be one of the good options for familiarizing society with robots.

Attitude Study 2

In the focus group study, LEOs expressed different points of view about considering robots as a help or hindrance in their work.

More presence or exposure has been stated as the first important reason why there is a positive attitude by the public towards robot use in law enforcement. Especially kids or young adults are inclined to new technologies since most of them all have a device in their hand many hours a day and so that is something they can relate to. Therefore, according to LEOs, to increase the exposure of robots in society, it is important to interact with young people and

build trust, which will open new possibilities and opportunities. A few LEOs mentioned that robots have capabilities beyond human abilities, which could be helpful in some scenarios.

LEOs mentioned that the public's attitude toward robots could be negative. They explained that some people may prefer a human to a robot and do not like to interact with a robot. This will pose a barrier to using robots in law enforcement. Also, it has been mentioned that robots can somewhat be intimidating in certain aspects. LEOs reported that robots are currently used for everyday situations but building a rapport with them is kind of out the window.

LEOs also emphasized education and training for the public to improve positive attitudes towards both law enforcement and robots. LEOs reasoned that currently there might be much misleading information regarding police. So, the first step would be educating the public about the police, how they do their job, what they are using, and what they are going to use the robot for. The public should be educated about robot use in law enforcement and how it is going to be used as a tool to help LEOs and improve their efficacy of work, safety, and also public safety. LEOs stated that using robots in law enforcement without educating the public would be very inappropriate because the public may not trust the police in some regard. This gap of understanding could be bridged with education. LEOs pointed out that schools are the best places to start public education since currently students are more exposed to new technology devices and feel comfortable working with them. Moreover, one way to do education would be asking for help from people who necessarily have influence in the community; who are outspoken in the community; or members of the media. At the same time, the training of LEOs was considered necessary by LEOs. This training could be on topics of robots, new technologies, communication skills and then also incorporate the technical aspects into LEOs' jobs. LEOs mentioned several other implementation barriers that need to be addressed, including lack of budget, cost and accuracy of new technologies.

Communication Study 1

Most LEOs in study 1 described communication via robots as good enough. Specifically, most LEOs believed communication using robots is more effective than human face-to-face communication. Many others reported that robots could provide safer communication compared to in-person communication, such as when communicating in a dangerous or barricaded situation. Moreover, robots offer functionalities such as translation and interpretation, as well as being able to communicate with disabled individuals.

Although most LEOs agreed that robots can be better at communication than in-person communication, some reported otherwise. Because of the lack of human contact, robots might not be good communicators despite the functionalities they can provide.

Communication Study 2

In the focus group study, LEOs reflected a generally positive attitude toward the communication ability of robots. In particular, it was repeatedly mentioned that robots provide more communication abilities and more information, as well as make communication more effective and convenient.

DISCUSSION

Regarding trust, most of the LEOs in both studies stated their low trust in the robot as it may fail during the operation. Another reason for this low trust could be the lack of similar communication robots already in use. Most LEOs are skeptical about embracing the new additions to the already in-use processes. Also, the reduction of face-to-face communication, which can degrade rapport, could play a crucial role in reducing LEOs' trust in the robot as it lessens the rapport between LEOs and citizens. Moreover, it is possible that robots turn against the LEOs through hacking. The type of situation is also a crucial parameter to the LEO's trust in the robot. Taking all this into account, adding new features such as online translating feature, weapon detection, emotion recognition, or improving the sensory features such as the addition of different types of cameras (e.g., thermal camera) to provide more information with higher accuracy can play a significant role in the increase of LEO's trust in communication robots. Previous research has demonstrated that the trust levels of LEOs increased following training (Bordbar et al., 2021). Consequently, there is considerable potential for their trust in robots to significantly increase with proper training and improved design.

Some LEOs had a positive attitude towards using robots as a tool in law enforcement since robots could be force multipliers; alleviate the possibility of perceived immediate danger; have capabilities beyond human abilities. Also, due to the recent advances in robotics, robots were believed by LEOs to be more accepted in the future, and this is a factor that increases LEOs' willingness to adopt robots in their work. However, others posed negative attitudes towards using robots in law enforcement and believed that robots could not be considered a good replacement for human officers since robots lack human sense and could not create a sympatric relationship with individuals. Also, the more LEOs rely on robots, the less they would have control of situations and their work which was considered one of the disadvantages of using robots. Moreover, there were some other reasons mentioned by LEOs, including robots being intimidated, expensive training on working with robots, and ethical issues using robots which pose a negative attitude towards robots. Consistent with existing literature, attitudes towards robots can be influenced by both human-related and robot-related factors (Hancock et al., 2011; Navarro et al., 2021), as well as cultural differences (Bartneck et al., 2005; Huerta et al., 2012) and self-efficacy (Latikka et al., 2019). It can be concluded that, depending on the situation, the use of robots as tools in law enforcement can be either helpful or a hindrance (Yunus & Doore, 2021; Szocik & Abylkasymova, 2021). However, training of officers and the public could solve the ambiguity and doubts regarding the benefits or drawbacks of using robots in law enforcement. Of course, this needs allocating budget to law enforcement departments in the first place to educate officers and then be able to purchase applicable robots for their work. Public education could be done with the help of community outreach and influencers.

In addition, safety was the primary focus concern of LEOs. When discussing the communication abilities of robots, LEOs envision the improvement of communication and its' ability to improve safety for officers and the public. Additionally, LEOs were hoping to use robots to gain abilities beyond human capabilities, such as practical and comprehensive interpretations. In general, LEOs trust robots' communication abilities and believe robots can assist in their work. Similarly, LEOs mentioned the safety concerns repeatedly in discussing

scenarios for robot implementation. For instance, by discussing some of the common scenarios that already use robots such as bombing and hostage, LEOs were hoping to use them as a tool to reduce dangerous exposures of the officers and the public. However, many still consider robots a force multiplier that can assist them in completing repetitive or mundane tasks. Either way, robots can greatly assist LEOs in their daily tasks.

Other considerations

When introducing new technology, especially robots in law enforcement, ethical considerations are crucial. These considerations can be addressed by adhering to established standards and guidelines in both robot design and use. In a previous study, LEOs expressed awareness of ethical issues and offered suggestions for addressing them, such as ensuring control over autonomous robots and developing ethical guidelines to hold them accountable. LEOs also emphasized that robots should be used as tools, not replacements for humans, and be mindful of potential distractions and lack of personal contact. Ethical guidelines and principles have been proposed by organizations like IEEE, which has published documents to guide ethical considerations in autonomous and intelligent systems. Standards have been established to minimize unethical impacts of robots, and responsible robotics should be built on best practices that involve stakeholder participation and multidisciplinary teams to eliminate bias (Salehzadeh et al., 2022). Integrated methods combining conceptual analysis and empirical studies are recommended for analyzing the impact of robots on humans. Salehzadeh et al. (2022) suggested aggregating stakeholder opinions to align future research with ethical guidelines. Thus, this study investigated robot design and use through participatory-based design and focus group interviews to guide the ethical use and design of communication robots in law enforcement.

This study utilized experiential learning for improving robot design. Experiential learning, combined with the integration of working prototypes, has been effectively and widely utilized in teaching students about the design and practice of robots (Resnick & Silverman, 2000; Verner & Korchnoy, 2013). Learning through design not only fosters a sense of community among learners (Resnick & Silverman, 2000, 2005) but also enables designers to gain experiential knowledge. This knowledge is crucial for understanding the needs, preferences, and challenges of end-users, ensuring that robots are designed with the user in mind, leading to more intuitive and user-friendly interfaces. Incorporating experiential knowledge into the design process allows designers to consider practical aspects of robot deployment, such as environmental conditions, human-robot interaction, and task-specific requirements. This ensures that the robot is effective in real-world scenarios. Moreover, experiential knowledge can inspire innovation by highlighting unmet needs or identifying areas for improvement, leading to novel solutions and enhancements that increase the robot's effectiveness and user satisfaction. Understanding user experiences and cultural contexts is vital for creating robots that are socially acceptable and less likely to face resistance from users or the public. Additionally, experiential knowledge can inform ethical considerations in robot design, ensuring that robots respect privacy, autonomy, and other ethical principles. Therefore, incorporating experiential learning into the design process is essential for ensuring seamless collaboration between humans and robots (Northeastern University, 2024).

Limitations

Despite the positive findings, this study still has some limitations. A larger sample would benefit our results, and we were hoping most LEOs could complete the whole study. Additionally, we had to overcome some coding challenges, such as overlapped coding. For instance, the communication and trust themes. Those were often mentioned together and hard to classify into categories. Some of them might be better interpreted as a whole. Therefore, the authors conducted several meetings to discuss coding strategies. Future researchers are encouraged to confirm the definitions of the categories that could be hard to differentiate before the coding process. Lastly, opinions from the public are needed regarding robot implementation in law enforcement. The next step is to gather information from the community and the public and explore what they hope to see in a robot that can contribute to their community life.

CONCLUSION

The two studies presented offer insight into various facets of employing teleoperated robots for communication between LEOs and citizens. Currently, while LEOs exhibit low trust in these robots, there is optimism that this trust can be enhanced through education, improved robot design, and technological advancements. It is evident that LEOs' attitudes towards robots are context dependent. However, through collaborative efforts between LEOs and the public sector, these robots have the potential to enhance the safety of both parties. Future research should delve into the community's perspectives on communication robots, shedding light on their acceptance and potential integration into public safety measures.

IMPLICATION

The findings of this study offer valuable insights for future research on communication robots in police work. By considering the opinions of LEOs regarding the use of robots in law enforcement, improvements can be made in robot design, functionality, and implementation. A well-designed robot can assist LEOs in their daily tasks, thereby contributing to the development of community relationships. It is important to note that the introduction of new technology in any domain brings forth concerns such as ethics, public privacy and perception, and public safety. These concerns should be addressed at all stages of robot design and deployment.

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Disclosure

This paper discusses the findings on LEOs' perspectives and attitudes towards communication robots. However, we fully acknowledge and value the perspectives of the civilians and the community that are impacted by the integration of robotic technology in law enforcement. Therefore, one of the future aims of this research project is to obtain and gather feedback from the public domain and various stakeholder communities in order to promote safety for both the LEOs and the civilians.

Moreover, it has been and will be our team's utmost priority to guarantee the confidentiality and privacy of all persons engaged in our technology development through proper approaches in consultation with privacy experts. In addition, our team acknowledges that a diverse array of perspectives and feedback from all community classes should be obtained, especially when inequality and inequity may exist. Our diverse research team consists of international and domestic scholars from marginalized communities, working-class people, and people of color who consistently discuss the needs of these communities and possible unintended consequences and potential impacts of these tools.

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