SUPPORTING PEDIATRIC ADL SKILL DEVELOPMENT USING SOCIAL ROBOTICS

A Thesis submitted to the faculty at Stanbridge University in partial fulfillment of the requirements for the degree of Master of Science in Occupational Therapy

by

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Abstract

This study aimed to analyze how parental perceptions and concerns about social robotic assistance affect activities of daily living (ADL) interventions for their child diagnosed with autism spectrum disorder (ASD). We explored this topic due to the growing use of social robotics in the medical field and emerging studies showing positive therapeutic outcomes from robotic integration. Our research question was: How do the perceptions of parents of children with ASD influence their likelihood of incorporating social robots into ADL interventions? We hypothesized that parents would have concerns about incorporating robotic assistance, making them less likely to integrate it into ADL tasks. To test this, we used a Google Form survey embedded with educational videos about social robots' roles in ADL interventions, supplemented by Likert scale questions and open-ended qualitative questions. Data from seven participants were analyzed using a Wilcoxon Signed Ranks test and Spearman's correlation for quantitative results, and thematic analysis for qualitative responses. The Wilcoxon Signed Ranks test revealed a significant increase in interest/benefit responses after watching the educational videos but no significant change in comfort level. Spearman's correlation showed a significant relationship between the current use of daily technology and both interest and comfort in using social robotics and between prior knowledge of social robotics and interest/comfort in their use. Qualitative analysis revealed key concerns regarding privacy, affordability, and usability but also highlighted potential benefits such as improved routine engagement. These results suggest that educational interventions can positively influence parents' willingness to consider social robotics in ADL interventions for their children. However, concerns remain that must be addressed to increase comfort levels.

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Supporting Pediatric ADL Skill Development Using Social Robotics

According to a systematic review written by Zeidan et al. (2022), the global prevalence of autism spectrum disorder (ASD) has increased significantly from 2012 to 2022. In response to the disorder's increased prevalence, a study was done involving 77 caregivers of autistic children to examine its impact on the respective caregivers of such individuals (Van Niekerk et al., 2023). Most parents and caregivers reported experiencing a mild to moderate care burden during their daily routine. This evidence of caregiver burden calls for action to be taken concerning the care of individuals diagnosed with ASD and increased support measures for their respective caregivers. In another study involving 21 children with ASD, five of the children scored extremely low on the Caregiver Assistance Scale regarding assistance in activities of daily living (Chi & Lin, 2022). The Caregiver Assistance Scale measures how much assistance children require to perform functional activities. Therefore, the children who scored a ten required maximum caregiver assistance, indicating an increased responsibility of caregivers who tend to children with ASD.

The integration of social robotics into human daily life is expanding. More specifically, social robotics are designed to communicate and build social relationships with humans by adapting to appropriate social behaviors (Haque Sunny et al., 2023). A study by Marino et al. (2020) found a significant effect of the social robot in boosting learning of socio-emotional understanding skills according to their comparison of pre-test and post-test results. This study emphasized how barriers to task engagement and emotional learning can be positively influenced by using social robots, thus increasing the individual's ability to participate in activities of daily living (ADL) tasks through pro-

social interactive play activities. This included the children interacting with the social robot and, in turn, the social robot providing verbal feedback, prompts, and reinforcing consequences in hopes of improving the children's emotion recognition skills, context-emotion association, identification between thoughts and emotions, and gaining skills to produce valuable thoughts (Marino et al., 2020). A similar study discovered that social robots can help children with ASD communicate better because the social robot decreases the likelihood of the child being overstimulated (Cano et al., 2023). These are just a few examples of emerging studies demonstrating the possible applications of social robots in facilitating learning and participation.

Despite the potential benefits of social robots, understanding how parental perceptions influence their adoption in everyday settings remains under-researched. Since parents play a central role in deciding whether to implement new technologies in their children's ADL interventions, their perceptions can either encourage or hinder the use of social robotics. Identifying these perceptions is essential for determining the factors that drive or deter their adoption. One way to positively shape parental perceptions is through education about social robotics, which can provide them with evidence-based information about the potential of social robotics and contribute to making informed decisions about social robotic integration in their own lives. As highlighted by Weerarathna et al. (2023), "Robotics growing incorporation into the healthcare system presents opportunities to improve patient care, maximize productivity, and tackle the most important issues facing the field today" (p. 9). Studies like this emphasize the potential benefits of social robotics for consumers, yet their integration into healthcare settings—especially within the home—still has considerable room for growth. For instance, a study by Mashizume et al.

(2021) revealed that occupational therapy practitioners see social robots as a valuable addition to therapy, suggesting that further exposure to the benefits of robotics could help address parental concerns and encourage their use in ADL interventions.

Additionally, the therapists within the Mashizume et al. (2021) study noted that implementing robotic assistance likely encourages functional independence in everyday tasks. Based on this understanding, we theorized that social robotics could effectively support these two concepts: promoting communication and fostering social relationships in the context of ADL tasks. While healthcare professionals recognize the potential benefits of social robots, there is limited evidence regarding their use in everyday households. Our study specifically sought to determine whether parental perceptions of social robotics influence their likelihood of incorporating them into ADL interventions for children with ASD. In addition, social robotics have the potential to assist in areas outlined in the "Occupational Therapy Practice Framework: Domain and Process—Fourth Edition" (American Occupational Therapy Association [AOTA], 2020) emphasize the importance of engagement and participation in occupation, indicating that there are interventions that can influence one's performance and overall engagement in activities.

Statement of the Problem

The purpose of our study was to survey the parents of children diagnosed with ASD to gauge their perspectives on the likelihood of integrating robotic assistance into their child's ADL interventions. The target population for this research includes parents of children with ASD who are either considering or have experience with robotic interventions in occupational therapy. Parents play a central role in the therapy process, and their engagement is critical to successful intervention outcomes. A 2021 study

highlights this by showing that increased parental involvement in pediatric rehabilitation sessions correlates with improved therapeutic outcomes, particularly for children diagnosed with autism (Davidson & Stagnitti, 2021). By understanding parental perceptions and concerns, therapists can better tailor interventions to meet the unique needs of both children with ASD and their families, ultimately enhancing therapy outcomes and promoting meaningful participation in daily occupations.

This study aligns with AOTA's "Centennial Vision" and the American Occupational Therapy Foundation's research agenda, emphasizing the need for innovative solutions in occupational therapy to address the evolving and complex needs of clients, particularly in pediatric care. By exploring the potential integration of social robotics in ADL interventions for children with ASD, this research contributes to AOTA's focus on enhancing participation and performance in meaningful occupations. Social robotics represents a novel approach to facilitating engagement in daily living tasks, a key priority outlined in the "Occupational Therapy Practice Framework," stressing the importance of interventions that foster independence and participation (AOTA, 2020).

Literature Review

Social Significance

In a world of technological advancement and the ongoing drive toward efficiency, manual labor jobs are evolving with the integration of robotic assistance. Caregiving, however, is a field known for its physical and emotional demands and is one area where human resources struggle to meet the growing demand (Bradwell et al., 2021). Traditionally, human caregivers have been the primary source for initiating self-care

activities, but emerging studies show that social robots can improve task conceptualization and social participation for individuals with developmental disabilities. For example, Marino et al. (2020) emphasized how social robots can positively influence barriers to task engagement and emotional learning, increasing participation in ADL tasks. Bradwell et al. (2021) examined interactions between residents of group care homes and companion robots designed to resemble familiar pets, providing interactive engagement and modified companionship. These studies demonstrate the significant positive impact of social robots on participants, supporting the theory that robotic assistance in everyday life may lead to beneficial outcomes.

Common Theme #1: Increased Need for ADL Assistance in Children With ASD

One central theme in the literature is the increased need for ADL assistance among children with developmental challenges, both physical and mental. Many children diagnosed with ASD need help with self-feeding and hygiene tasks. Naik et al. (2019) aimed to investigate the primary challenges of raising a child with ASD and how this diagnosis affects the child's ability to complete ADL tasks. The study included 20 parents of children aged 5 to 9 years with a primary diagnosis of ASD. Through voluntary participation, these parents completed a semi-structured questionnaire, and researchers found that the ASD diagnosis significantly affects the child's ability to perform ADL tasks, with various challenges reported by parents related to both the child's functional abilities and the support needed to assist with these tasks.

Singh et al. (2017) found that children with Prader-Willi syndrome experienced increased difficulty managing emotions and maintaining a healthy body weight due to the compulsive nature of the diagnosis. This study implemented a mindfulness intervention

to reduce maladaptive behavior and promote healthy coping mechanisms and self-awareness. Parents and guardians were trained in mindfulness techniques to help the children self-regulate rather than compulsive eating or emotional outbursts. While this study utilized a human-delivered intervention, other studies incorporated social robots to achieve similar results.

Marino et al. (2020) also acknowledged developmentally challenged children's difficulties in ADL tasks, proposing that robotic assistance could help overcome these barriers. In Singh et al. (2017), parents and researchers facilitated the intervention according to participant responses. Marino et al. (2020) used a therapist specializing in cognitive behavioral therapy techniques to control a humanoid robot called NAO. This robot interacted with children aged 4 to 8, providing communication prompts, social reinforcement techniques, and emotional engagement under the therapist's partial control. The robot collected behavioral response data to examine the intervention's effects. Marino et al. (2020) and Singh et al. (2017) demonstrated significant improvements in ADL engagement, though the interventions differed significantly in their facilitation.

Common Theme #2: The Versatility and Impact of Robot Assistance in Managing Care for Children

Another central theme is the versatility and impact of robot assistance in managing care for children, as shown in numerous studies. The study by Marino et al. (2019) demonstrated that using social robots to teach socio-emotional skills to children with ASD improved contextualized emotion recognition, comprehension, and emotional perspective-taking. The study used the Test of Emotional Comprehension and the Emotional Lexicon Test, concluding that children exposed to the robot showed a 59%

($p=0.001$) increase in total scores compared to a control group without robot exposure, which showed no significant change (21% increase, $p=0.159$). Similarly, Van den Berk-Smeekens et al. (2022) found that children with ASD exposed to robot assistance had increased attention and motivation compared to those without robot assistance. The qualitative study by Logan et al. (2019) indicated increased positive behavior with children's exposure to social robots as opposed to those who were given a plush stuffed animal during the therapeutic intervention.

Ismail et al. (2020) further validate the efficacy of robot-assisted interventions by demonstrating the improvement of attention skills in children with cognitive impairments through interactive sessions with a social robot, Learning Universal Cognitive Assistance (LUCA). Their findings show notable enhancements in attention and engagement, as evidenced by decreased task completion times and increased interaction periods with the robot. These studies collectively illustrate the adaptability of robotic assistance in therapeutic contexts. Marino et al. (2019) applied cognitive behavioral therapy integrated with robotic capabilities, while Van den Berk-Smeekens et al. (2022) used pivotal response treatment. Ismail et al. (2020) focused on attention skills, demonstrating robotics' potential in addressing varied developmental challenges, from enhancing cognitive functions to improving socio-emotional skills in children with ASD and cognitive impairments.

Statement of Purpose, Hypothesis, and Research Question

The purpose of this study was to investigate how parental perceptions and concerns regarding robotic assistance act as barriers to adopting ADL interventions for children diagnosed with ASD. Our central research was, how do the perceptions of

parents of children with ASD influence their likelihood of incorporating social robots into ADL interventions? Due to the lack of literature showcasing the use of social robots in everyday households (Dosso et al., 2023), we hypothesized that many parents of children with ASD would express concerns about utilizing robotic assistance, which would consequently make them less inclined to integrate robotic assistance into ADL tasks. To explore this hypothesis, we employed a structured framework throughout our study. The population under the study consisted of parents or guardians of children aged 3 to 18 years diagnosed with ASD. The intervention involved administering a Google Form survey and providing educational videos to inform participants about social robots' role in ADL interventions. We made comparisons by assessing parents' perceptions and willingness before and after exposure to educational content. The study's outcome measures evaluated changes in parental perceptions regarding using social robots in their children's ADL interventions. Our data collection included surveys, in-depth questionnaires, and open-ended inquiries to gather insights into parental perspectives and concerns regarding robotic interventions. By examining those factors, we sought to enhance our understanding of how parental perspectives influence the integration of robotic technologies aimed at improving ADL outcomes for children with ASD.

Theoretical Framework: Model of Human Occupation

The Model of Human Occupation (MOHO), initially developed by Gary Kielhofner in 1980, offers a robust and comprehensive framework for understanding the complex interplay between individuals and their occupational environments (Kielhofner, 2008). MOHO was founded on the premise that occupation is determined through the dynamic interactions among three primary elements: volition, habituation, and

performance capacity. This model has been extensively applied across a broad range of occupational therapy interventions. It is particularly suitable for research involving innovative technologies like social robotics in therapeutic settings for children with ASD.

Volition is the process by which individuals choose and experience their occupations, influenced by their values, interests, and perceived capacities (Kielhofner, 2008). In the context of our study, volition was the critical factor as it addressed the motivations and willingness of parents to incorporate social robotics into the ADLs of their children with ASD. By exploring volition, we aimed to uncover the underlying beliefs and values that guide parents' decisions regarding adopting robotic aids. This understanding is pivotal as it affects how parents perceive the usefulness and appropriateness of social robotics in assisting with ADL tasks.

For example, parents who value technological innovation and believe in its potential to enhance learning and development might be more likely to be receptive to integrating social robots into therapy (Tomchek & Koenig, 2016). Conversely, parents who prioritize human interaction or are skeptical about robotic interventions' efficacy may exhibit reluctance. This dichotomy in parental attitudes can significantly influence the therapeutic choices made for their children, thereby affecting the child’s engagement in essential ADLs.

Habituation in MOHO reflects the patterns and routines that organize behavior, including individuals' roles and routines (Kielhofner, 2008). Our research has examined how introducing social robots can alter existing family routines or aid in establishing new ones that support the engagement of children with disabilities in everyday life. Analyzing

habituation provides insights into how robotic interventions can be embedded into daily routines to enhance their acceptability and effectiveness.

For instance, if a social robot that aligns with established family routines is introduced, it might be more likely to be embraced by both the child and the parents. This integration could facilitate smoother transitions for children with ASD, who often rely on consistent routines to navigate daily activities (Case-Smith & Arbesman, 2008). Furthermore, understanding these routines can help design robot-assisted interventions that are effective and sustainable in the long-term home and clinical settings. Performance capacity involves the physical, emotional, and cognitive abilities that enable individuals to engage in occupations (Kielhofner, 2008). In the realm of ASD, where sensory and cognitive impairments often present significant challenges, the capabilities of social robots to adapt to and address these needs are particularly relevant. This study explored how robotic technologies can enhance these capabilities, facilitating better engagement in ADL tasks.

Robots, such as those designed for social interaction, can offer unique stimuli that engage sensory, cognitive, and emotional faculties in children with ASD (Cabibihan et al., 2013). They can provide consistent, repeatable, and controlled interactions that are often difficult to achieve in human-delivered interventions. By examining performance capacity through the lens of MOHO, further research can assess whether and how robotic interventions can improve task engagement and completion, enhance the child's independence, and eventually reduce caregiver burden.

Integrating MOHO into this study offered a structured way to investigate the complex factors influencing the adoption of robotic interventions by parents of children

with ASD. By examining volition, habituation, and performance capacity, our research aimed to comprehensively understand the factors that facilitate or hinder the use of social robotics in therapeutic settings. This approach not only aligns with the holistic perspective of occupational therapy but also enhances the potential to develop targeted interventions that are responsive to the needs and preferences of children with ASD and their families. By considering these environmental influences alongside the child's volition, habituation, and performance capacity, researchers can further identify barriers and facilitators to adopting robotic interventions within the family context. This broader perspective enables the development of interventions that not only target individual needs but also address systemic challenges, ultimately promoting more sustainable and effective support for children with ASD and their families.

Methodology

Through our descriptive research design, we employed a pre-post educational intervention survey approach, primarily aimed at evaluating changes in parental willingness to use social robotics for ADL interventions for children with ASD. We chose this design for its direct assessment of the impact of educational information on parents' attitudes toward technology usage in therapeutic settings.

Recruitment and Consent

Recruitment and consent procedures began with obtaining approval from the Stanbridge University Institutional Review Board to ensure ethical standards in research. The research team emailed and called pediatric occupational therapy clinics, schools, and social media groups to obtain permission to post recruitment flyers at their physical or online sites. We collectively reached out to 12 pediatric clinics and two social media

groups. We received approval from the two Facebook groups, denial from four clinics, and no response from the other eight clinics.

The flyers briefly explained the study and included a QR code link to the online survey. We followed up with communication via email or phone two weeks after the initial flyer distribution to remind potential participants and address any queries about the study.

Target Population: Inclusion and Exclusion Criteria

We designed the study's inclusion criteria to select a specific population of interest that could provide relevant and meaningful insights. Participants needed to be parents or primary caregivers of children diagnosed with ASD. Additionally, these children must have been between 3 and 18 years old to ensure that the developmental stages are appropriate for the interventions discussed. Participants were required to be able to read and understand English, as the survey and educational materials were provided in English. Furthermore, access to an internet-capable device was necessary to complete the online survey.

Conversely, we established the exclusion criteria to maintain the study's focus and ensure the safety and well-being of participants. Individuals who did not provide consent, whose children did not have ASD, or who were not within the inclusion age range were excluded from the study. Parents or caregivers of children with severe comorbid conditions that significantly impair daily functioning (e.g., profound cognitive disability, severe physical impairments, or blindness) were also excluded, as these conditions may overshadow the effects of ASD and robot assistance in ADLs. Lastly, we excluded occupational therapy students and experts in occupational therapy or robotic health

technology from our study, as our primary focus was to gather data that best represents the general parental population.

Survey Execution

The survey included 15 questions, including 3 screening questions, 7 pre-video questions, and 5 post-video questions, and was structured as follows: Participants needed to accept the consent form by clicking the “Agree” button when prompted to proceed with the survey; if denied, the survey prompted the participants to end. Screening questions confirmed if the participant was a parent or guardian of a child aged 3 to 18 years old and if the child had been formally diagnosed with ASD. The screening questions included questions regarding the child’s age, formal diagnosis of ASD by a licensed healthcare professional, whether the participant is in the occupational field, and whether the child has any impairments or disabilities besides ASD.

Pre-test questions assessed the participant's familiarity with social robotics for children, comfort level with using social robotics to assist with their child's daily activities, the likelihood of considering social robotics for ADL interventions, and primary concerns about using social robotics for their child’s ADL interventions. The pre-test questions were:

- Does your child currently participate in any therapeutic interventions for ASD, such as occupational therapy, speech therapy, or other related services? (e.g., OT, speech therapy)? (Yes/No)
- Do you use any technology devices with your child daily at home (e.g., Alexa, Google Home, tablets, smartphones)? If yes, please explain. (Yes/No, with an open-ended response for "If yes, please explain")

- Are you familiar with the use of social robotics in therapeutic interventions for your child? (if you answered 'yes' above, please describe your personal experiences and level of familiarity with the use of social robotic interventions for children in the "other" selection)
- How interested would you be in using social robotics to assist with your child's activities of daily living (i.e., grooming, bathing, dressing, play, school, etc.)? (1 = Not Interested, 2 = Somewhat Less Interested, 3 = Neutral, 4 = Somewhat More Interested, 5 = Very Interested)
- If presented with the opportunity to incorporate social robotics into your child's interventions, how comfortable would you be integrating them into your child's life? (1 = Very Comfortable, 2 = Somewhat Less Comfortable, 3 = Neutral, 4 = Somewhat More Comfortable, 5 = Very Comfortable)
- What are your primary concerns about using social robotics for your child's ADL interventions? (Open-ended response)

Participants watched three publicly available YouTube videos introducing the social robots Moxie, Milo, and QT, developed by Embodied Inc. (www.embodied.com), RoboKind (www.robokind.com), and LuxAI (www.luxai.com), respectively. These robots were selected for their therapeutic applications and growing use in interventions with children, particularly those with ASD. The videos highlighted key features and their potential to support ADL tasks.

Research has shown promising results in fostering emotional understanding and social engagement in children with developmental delays (Embodied, 2023). Milo, a humanoid-type robot, focuses on improving social communication and emotional

regulation for children with ASD. Studies have demonstrated that Milo can reduce anxiety and increase participation in social activities by offering structured, predictable interactions (RoboKind, 2020). Finally, QT, designed by LuxAI, is geared toward teaching social skills through therapeutic interaction. Research indicates that QT can decrease overstimulation and improve social participation in children with ASD (LuxAI, 2023; Puglisi et al., 2022).

The YouTube videos provided a brief yet comprehensive overview of each robot's functionality in therapeutic and educational contexts. Our research team did not create the videos but chose them for their relevance to our topic. Each video lasted about two minutes and 30 seconds, introducing the robots' roles in supporting ADL tasks through interactive and structured interventions. Moxie's video focused on its play-based learning approach, Milo's video demonstrated its role in emotional development and transferring learned interaction skills to real-life scenarios, and QT's video showcased its therapeutic social skills training (Embodied, 2023; LuxAI, 2020; RoboKind, 2020).

Through the post-test questions, we reassessed participants' comfort levels with using social robotics for their child's ADLs, their interest in receiving assistance from social robots for specific ADLs, their beliefs in the benefits of social robotics for their child's daily living skills, and any primary concerns about using social robotics after the educational session. The post-test questions were:

- After receiving the educational information, how comfortable would you be with incorporating social robotics into your child's daily activities? (1 = Not Comfortable, 2 = Somewhat Less Comfortable, 3 = Neutral, 4 = Somewhat More Comfortable, 5 = Very Comfortable)

- What activities of daily living would you be most interested in assistance from a social robotic? (Multiple choices: routines (morning, night, school), schoolwork, dressing, grooming, toileting, eating, sleeping, other)
- To what extent do you believe social robotics can benefit your child's daily living skills after the educational session? (1 = Not Beneficial, 2 = Slightly Beneficial, 3 = Moderately Beneficial, 4 = Very Beneficial, 5 = Extremely Beneficial)
- After watching the educational video, what do you think the benefits would be to utilize a social robot in assisting with your child's ADLs? (Open-ended response)
- After watching the educational video, what are your primary concerns about using social robotics for your child's ADL interventions? (Open-ended response)

Advantages of Online Surveys

We chose online surveys for their wide reach, allowing data collection from a geographically dispersed participant base without the logistical costs and complexities associated with traditional methods (Wright, 2005). Online surveys also offer convenience, as participants were able to complete the survey at a time and place that was most convenient for them, which has been shown to potentially increase the response rate (Dillman et al., 2014). According to Dodou and de Winter (2014), "Recent research has demonstrated that online surveys can reduce social desirability bias due to the perceived anonymity they offer, which encourages participants to provide more honest responses."

Data Collection Instruments

We used Google Forms as the survey platform due to its user-friendly interface and robust data collection capabilities. The survey included both Likert scale and open-ended questions to gather quantitative and qualitative data. The Likert scale questions

were designed to measure participants' levels of interest and comfort with using social robotics in ADL interventions for their children, both before and after watching the educational videos. These questions allowed us to capture changes in perception, providing measurable insights into the impact of the educational intervention. In contrast, the open-ended questions provided participants the opportunity to elaborate on their personal concerns, experiences, and thoughts about social robotics, giving us rich qualitative data to identify recurring themes.

For the educational materials, we selected videos featuring Moxie, Milo, and QT based on an online search for relevant content and guidance from the thesis advisor and pediatric OTP, Dr. Shain Davis. The videos were chosen to illustrate these robots' therapeutic interactions and potential use cases with children diagnosed with ASD. Before finalizing the video selections, our team engaged in hands-on interactions with each robot to better understand their capabilities and functionalities, ensuring that the educational content was both accurate and relevant to the study’s objectives.

The survey questions and educational materials underwent a validation process to ensure their accuracy, clarity, and relevance. This process involved selecting educational videos in collaboration with Dr. Davis to align with the therapeutic needs of children with ASD. Additionally, we reviewed the survey with members of the Learning Resource Center at Stanbridge University to confirm the clarity and comprehensibility of the materials for a general audience. Based on their feedback, we made final adjustments to enhance the survey's clarity, readability, and overall effectiveness.

Data Analysis Plan

The data analysis employed both qualitative and quantitative approaches to assess how educational interventions impacted parental perceptions of social robotics in ADL interventions for children with ASD. For the qualitative analysis, we planned to conduct a thematic analysis of the open-ended survey responses. Each researcher would independently code the data to identify critical themes such as privacy concerns, usability, affordability, and the perceived benefits of social robotics. This approach aimed to ensure the analysis captured a broad range of perspectives. To enhance reliability, we planned to use triangulation by comparing and discussing the initial coding results among the research team. Through this process, we would reach a consensus on the most relevant themes, ensuring that the qualitative data were interpreted consistently and accurately.

For the quantitative analysis, we collaborated with the Stanbridge University statistician, who assisted in processing the Likert scale data. Descriptive statistics, including mean, median, and standard deviation, would summarize changes in parental interest and comfort levels before and after the intervention. Given the small sample size and non-normal distribution of the data, we applied the Wilcoxon Signed-Ranks test to assess the significance of changes in parental attitudes. Additionally, we conducted Spearman's correlation to explore potential relationships between prior technology use, familiarity with social robotics, and changes in parental interest and comfort. This approach would help us determine if prior exposure to technology influenced parents' openness to adopting social robotics in ADL interventions.

By combining qualitative and quantitative methods, this data analysis plan was designed to capture both the measurable effects of the educational intervention and the more subjective concerns voiced by parents. This mixed-methods approach provided a well-rounded perspective on social robotics's potential feasibility and acceptance in therapeutic contexts.

Ethical and Legal Considerations

In conducting this study, we followed all ethical and legal guidelines as mandated by our institution. Institutional Review Board approval was obtained from Stanbridge University before data collection to ensure that participant rights and well-being were prioritized throughout the study. Each participant provided informed consent electronically before beginning the survey, acknowledging their understanding of the study's purpose, risks, and benefits.

Participants were assured that their responses would be treated with strict confidentiality. No identifying information was collected, and all survey data were anonymized to protect participant privacy. The data was securely stored in a password-protected Google Drive, accessible only to the research team. Data storage and handling adhered to ethical guidelines for confidentiality, with data to be retained for up to three years following the study before being securely deleted.

Additionally, we took measures to ensure cultural sensitivity during recruitment and data collection. The survey language was crafted to avoid bias and ensure inclusivity so that all parents, regardless of background, could feel comfortable participating. By adhering to these protocols, we aimed to minimize risks to participants while ensuring the integrity of the research process.

Results

For our study, we recruited a total of seven participants, all of whom were parents or guardians of children aged 3 to 18 years who had received a formal diagnosis of ASD from a licensed healthcare professional. Of these participants, six reported that their children were currently involved in therapeutic interventions, including OT, speech therapy, or applied behavior analysis therapy. One participant indicated that their child was not receiving these services at the time of the study. Regarding technology use, six participants stated that they regularly use devices such as Alexa, Google Home, tablets, or smartphones with their children to assist in daily routines. One participant reported using a communication tablet to support their child's communication. These responses suggest that most participants were familiar with integrating technology into their children's daily lives, providing an appropriate context for assessing their openness to using social robotics in ADL interventions.

Qualitative Results

In assessing parents' perspectives on using social robotics for their children's ADL interventions, open-ended responses revealed concerns and potential benefits. The most common concerns revolved around family privacy, the usability of the technology, and its affordability. Some parents were worried about how the robot might impact family privacy and the security of personal data, with one parent stating, "I guess if it malfunctions and any limitations as to where we could use it in his social life, e.g., airplanes, car, at school, etc." (Participant 5). Usability was another significant concern, with participants expressing fears about the robot malfunctioning or breaking, particularly in stressful situations. One parent shared, "Something goes wrong and/or

breaks if she becomes upset" (Participant 4), highlighting concerns about the robot's reliability. Cost also emerged as a frequent issue, with parents questioning the affordability and accessibility of such technology. One parent noted, "It looks expensive and I don't even know where this type of service is offered" (Participant 2). Others expressed discomfort with integrating social robotics into daily interventions, wondering how well it would translate to real-life scenarios without technology, as voiced by one participant: "It seems unnatural to involve technology in such interventions. How would this transfer to regular life?" (Participant 3).

After watching the educational video, parents identified several potential benefits of using a social robot to assist with their children's ADLs. Many participants noted that the robot could provide consistent reminders and cues, helping to establish routines, and it is especially useful for working parents who may not always be available to offer consistent support. One parent shared, "It might help with reminders and giving cues that I might not be able to provide often enough since I work full time" (Participant 2). Some parents believed that the robot could make daily tasks more engaging for their children by turning them into a game, which could encourage participation in activities their children typically avoid. As one parent observed, "I really think this could help encourage my son to do activities that he doesn't like. It makes it like a game" (Participant 5). Another parent emphasized the potential effectiveness of social robots, particularly for children who respond well to electronics: "Since he responds well to electronics (particularly, his iPad) this robot could potentially get through to him and impact his development more than what methods we have currently employed" (Participant 7). Overall, parents felt that

social robotics could enhance their child's therapy by providing continuous support and motivation.

However, concerns about using social robotics for daily activities remained after watching the video. Parents continued to express worries about the technology's usability and affordability. Some noted that it seemed financially expensive and were unsure where the service would be available and accessible, while others were uneasy about their children having unrestricted access to technology, fearing overuse or dependency. One parent mentioned, "I'm uncomfortable with my child having access to technology 24/7" (Participant 3). Specific concerns included the potential for the robot to break or malfunction, particularly when the child might become upset. While some parents were generally open to the idea, others, particularly those with older children, felt their child might not be interested in interacting with a robot, as one parent stated: "My daughter is 17 and probably wouldn't be interested in this" (Participant 6). A primary concern was also how and where the robot could be effectively used in various environments, such as at school, in the car, or on airplanes.

Quantitative Results

We used a Wilcoxon Signed Ranks test to evaluate the impact of educational videos on parents' interest and comfort levels regarding the use of social robotics in ADL interventions. The test revealed a statistically significant increase in participants' interest or perceived benefit after viewing the educational videos, with a pre-video mean of 3.25 and a post-video mean of 3.75 ($p = 0.046$; see Table 1). This suggests that the educational content positively influenced parents' perception of the potential benefits of social robots. However, no significant change was observed in participants' comfort levels before and

after watching the videos. The mean pre-video comfort level was 3.63, and the post-video mean was 3.38 ($p = 0.480$), indicating that while the videos may have influenced interest, they did not significantly alter parents' comfort with the idea of integrating social robotics into their children's daily lives (see Table 1).

In addition, we conducted a Spearman's correlation test to examine relationships between daily technology use, prior knowledge of social robotics, and participants' interest and comfort with these technologies. There was a strong correlation between daily technology use and interest/comfort in using social robotics, with a Spearman's correlation coefficient of $rs = 0.877$ ($p = 0.010$; see Table 2). Similarly, participants with prior knowledge of social robotics expressed higher interest and comfort ($rs = 0.898$, $p = 0.015$; see Table 2). These findings suggest that familiarity with technology and prior knowledge of social robotics may influence parents' openness to incorporating social robots into their children's ADL interventions.

Discussion

The findings of this study provide key insights into the potential of social robotics in ADL interventions for children with ASD. Our quantitative data revealed a significant increase in parental interest after watching the educational videos. However, no significant change was observed in comfort levels, suggesting that while parents may acknowledge the benefits, they remain hesitant about incorporating robotic assistance into daily activities.

In terms of our research question, the findings present a mixed answer. While we observed increased interest in using social robots for ADL interventions, this did not translate into a significant shift in comfort levels. This suggests that educational

interventions can raise awareness and highlight potential benefits, but they may not be sufficient to overcome deeper concerns about integrating social robotics into daily routines. Therefore, the hypothesis that concerns would make parents less likely to adopt robotic assistance in ADL tasks was partially supported interest increased, but barriers to comfort remain.

A notable finding is the strong correlation between daily technology use and interest/comfort in using social robotics. Parents familiar with technology were likelier to express interest and comfort in integrating social robots into ADL tasks. This suggests that the feasibility of incorporating social robots into households may be greater where technology is already prevalent. Similarly, participants with prior knowledge of social robotics demonstrated higher levels of comfort and interest, indicating that familiarity and understanding play crucial roles in acceptance.

Our qualitative data reinforced these concerns, with parents frequently voicing worries about privacy, usability, and affordability. For example, one parent noted concerns about how and where the robot could be effectively used in daily life: “I guess if it malfunctions and any limitations as to where we could use it in his social life, e.g., airplanes, car, at school, etc.” (Participant 5). Another parent highlighted usability concerns, stating, “Something goes wrong and/or breaks if she becomes upset” (Participant 4). These comments suggest that future interventions need to focus not only on the potential benefits of social robotics but also on mitigating these key concerns.

Providing hands-on experiences with social robots, in addition to educational videos, may help alleviate some usability concerns and improve comfort levels. Further,

offering transparent and accessible information about data security and the affordability of these technologies may encourage broader acceptance among parents.

Possible Limitations of the Project

One significant limitation of this study is the small sample size. With only seven responses, the data set is limited, which restricts the generalizability of our findings. A larger sample size would have allowed for more robust statistical analysis and a better representation of the broader population of parents of children with ASD. The small sample also reduces the variability of responses, making it difficult to capture a wider range of parental perspectives on social robotics. Future studies should aim to recruit a larger, more diverse sample to increase the reliability and validity of the findings. Another limitation is the recruitment process. The study was constrained by the limited timeline available for recruitment, which restricted our ability to reach a larger pool of participants. Extending the recruitment period could have resulted in a larger and more representative sample. Additionally, we did not offer incentives for participation, which may have further affected engagement. A recent study by Abdelazeem et al. (2022) indicates that offering monetary or other incentives can increase participation and response rates by as much as 95%. While participant drop-outs were not a concern due to the non-longitudinal design of the study, the initial recruitment challenges may have impacted the overall sample size and response rate.

Another critical limitation was the inclusion of participants who did not meet the inclusion criteria. Some participants failed the screening questions but were still included in the analysis due to the small sample size. We had two participants who failed the screening questions out of our seven participants due to having a child who had other

impairments or disabilities aside from ASD that may have included cognitive disabilities, severe physical impairments, blindness, etc. This decision may have impacted the results by introducing data from individuals whose experiences or perspectives did not fully align with the study's intended population (parents of children with ASD). While this inclusion helped to increase the sample size, it could have diluted the specific insights related to the target population and influenced the overall findings.

Additionally, participants may have lacked full comprehension of the significance of the study due to its focus on social robotics, a relatively new and unfamiliar field for most people. Although we attempted to bridge this gap by incorporating educational videos, many participants might not have had prior exposure to or experience with social robotics. The novelty of the topic affected their ability to engage with and respond to the questions fully. This lack of prior knowledge may have also influenced their comfort levels, as our results showed no significant increase in comfort after watching the videos. Future studies could benefit from offering hands-on experiences with social robots or more interactive educational methods to provide participants with a more practical understanding of the technology.

A further limitation is the educational material used in the study. While the videos were intended to educate participants about social robotics, they may not have fully addressed some of the participants' core concerns, such as privacy, usability, and affordability. Other methods of educational media, such as live demonstrations or interactive sessions, may have a greater impact on changing perceptions and improving comfort levels with the technology. As our results indicated, the videos effectively

increased interest but did not significantly improve participants' comfort levels in integrating social robotics into their children's lives.

Finally, this study was conducted with a very specific population—parents of children diagnosed with ASD. As a result, our findings may not be generalizable to other populations, such as parents of children with other developmental disabilities or neurotypical children. The inclusion criteria limited participation to those with specific experiences, and future research should explore how perceptions of social robotics may vary across different groups.

These limitations underscore the need for further research to expand upon our findings and address the concerns identified by our participants. A larger sample size, broader recruitment efforts, and more diverse educational interventions could help to refine our understanding of how social robotics might be integrated into pediatric OT.

Conclusion

Our study demonstrates the potential for educational interventions to increase parental interest in using social robotics for children's ADL interventions. However, concerns about comfort, privacy, usability, and affordability persist, which must be addressed to make the widespread adoption of these technologies feasible.

While we observed a significant increase in parental interest following the educational videos, the lack of change in comfort levels suggests that deeper concerns need to be resolved before social robotics can be fully integrated into therapeutic settings. Future research should explore more interactive educational experiences and provide hands-on demonstrations of social robotics to investigate how these technologies can be effectively used in daily living interventions.

This study also aligns with AOTA's "Centennial Vision" goals by demonstrating the potential for innovative interventions that foster independence in ADL tasks (AOTA, 2007). However, occupational therapists must consider families' comfort levels and concerns as they introduce new technologies in therapeutic interventions. By addressing privacy, usability, and affordability, therapists can better advocate for the inclusion of robotics in therapy settings, making meaningful advancements in the use of technology to support ADL skill development for children with ASD.

In conclusion, while educational interventions can significantly increase awareness, further steps are needed to address the barriers to comfort and promote the broader integration of social robotics into everyday life.

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Table 1

Wilcoxon Signed Ranks Test

Items	**Phase**	***N***	***Mean***	***p***
1. Was there a significant change in response of interest/benefit response pre- and post-video?	Pre video	8	3.25	.046
	Post video	8	3.75	
2. Was there a significant change in comfort level response pre- and post-video?	Pre video	8	3.63	.480
	Post video	8	3.38	

Table 2

Spearman's Correlation Test

Items	**Phase**	***N***	***Spearman's r***	***p***
3. Is there a relationship between the current use of daily technology and interest/comfort in potentially using social robotics?[a]	Interest	7	.877	.010
	Comfort	7		
4. Is there a relationship between current knowledge/understanding of social robots and interest/comfort in using them?[b]	Interest	6	.898	.015
	Comfort	6		

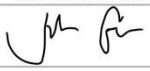
Note: [a]Reflects those who said yes to, "Do you use any technology devices with your child on a daily basis at home?" Only 1 case said no but cannot use in comparison. [b]Reflects those who said no to, "Are you familiar with using social robotics in therapeutic interventions for children?" Only 1 case said yes and 1 was missing, thus cannot use in comparison.

Appendix A

Institutional Review Board Approval

Dear Dr. Shain Davis and Students,

The Stanbridge University Institutional Review Board has completed the review of your application entitled "Parental Perspectives on the Use of Social Robotics in Occupational Therapy Interventions for Children with Autism Spectrum Disorder." Your application (#06MSOT013) is approved and categorized as Expedited.

IRB Application Number	#06MSOT013
Date	08/20/2024
Level of Review	Expedited
Application Approved	X
Conditional Approval	
Disapproved	
Comments	The requested Minor changes have been reviewed and confirmed as completed by the IRB. (08/20/2024)
Signature of IRB Chair	

Please note that any anticipated changes to this approved protocol requires submission of an IRB Modification application with IRB approval confirmed prior to their implementation.

Sincerely,
Julie Grace, M.S., M.A.
IRB Chair

Appendix B

Site Approval Forms

Research Site Agreement Form
Stanbridge University

AGREEMENT

Research Site: Registered Behavior Technician (RBT), ABA, Autism, ADHD, Special Needs group

Research Site Address: Private Facebook Group

Title of Proposed Research: Parental Perspectives on Social Robotics in Occupational Therapy Interventions for children with ASD

RESEARCH STUDY INFORMATION

Student Investigator(s) Name(s):

1. McKenna Zhang
2. Makenna Allen
3. Julianna Bui
4. Kiana Saebi

Principle Student Investigator Name: McKenna Zhang

Email address: Mckenna.zhang@my.stanbridge.edu Phone Number: (949)554-7020

Duration of the study: July 2024-October 2024

Authorization Effective Date: July 15th, 2024 Authorization Expiration Date: October 31st, 2024

Allowed Number of Contact Hours: N/A The study will be completed by (date): Oct 31st, 2024

Description of Research:

This mixed methods study will identify and examine the perceptions of parents and guardians of children diagnosed with Autism Spectrum Disorder (ASD) concerning the use of social robotic intervention. Our primary research question is: How do the perceptions of parents of children diagnosed with ASD affect their likelihood of incorporating social robots into Activities of Daily Living (ADL) interventions? Participants will be asked to complete an online survey via Google Forms and watch educational media surrounding the concept of social robots. We will be comparing the pre-test and post-test data relating to the perceptions of social robots to identify correlating evidence.We will not be collecting any identifiable data from our participants such as names or emails when they complete the survey.

DocuSign Envelope ID: FA69B217-C4A5-4F3A-8DA2-0BFCB47224DD

Research Site Agreement Form

Stanbridge University

Intellectual Property Statement:

Stanbridge University reserves the right to use, publish, and disseminate the results of the research findings. The University shall provide the research site with a copy of the final research product at the earliest practicable time.

Thesis Advisor Contact Information:

Name: Shain Davis

Email address: sdavis@stanbridge.edu Phone Number: 562-242-6830

RECRUITMENT PLAN

Means by which the researcher(s) will contact and/or recruit participants:

We plan to collect data for our study using an anonymous online survey and would like to post study flyers at your site to recruit participants.

We are seeking to recruit parents or guardians of childre ages 3 to 18 years old who have been diagnosed with ASD. Our surveys will be administered anonymously via Google Forms without collecting identifying information from the participants, such as name, age, etc.

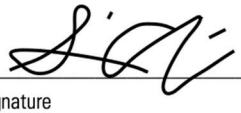
SITE REPRESENTATIVE AGREEMENT

I agree to the recruitment and data collection methods to be used in this study, and I authorize the investigator to conduct research at:

Facility Name/Research Site Name: Facebook Group *see name above

Representative authorizing agreement: Sadia Ammad

Title: Owner of Facebook Group



Signature

6/23/24

Date

dSign Envelope ID: FA69B217-C4A3-4F3A-8DA2-0BFCB47224DD

Research Site Agreement Form
Stanbridge University

STANBRIDGE UNIVERSITY AGREEMENT SIGNATURES

I/We accept the terms of this agreement.

Student Investigator 1: McKenna Zhang Title: MSOT student

DocuSigned by: Mckenna Zhang F8B43EB1B6724BC... — 6/20/24

Signature Date

Student Investigator 2: Makenna Allen Title: MSOT student

DocuSigned by: Makenna Allen 7C9229D41EBD433... — 6/20/24

Signature Date

Student Investigator 3: Julianna Bui Title: MSOT student

DocuSigned by: 3955C8DF985C4D0... — 6/20/24

Signature Date

Student Investigator 3: Kiana Saebi Title: MSOT student

DocuSigned by: KianaSaebi EC1C4E44BCEA466... — 6/20/24

Signature Date

Faculty Thesis Advisor: Shain Davis Title: OTD, OTR/L

6/18/24

Signature Date

Program Director: Myka Persson Title: PD

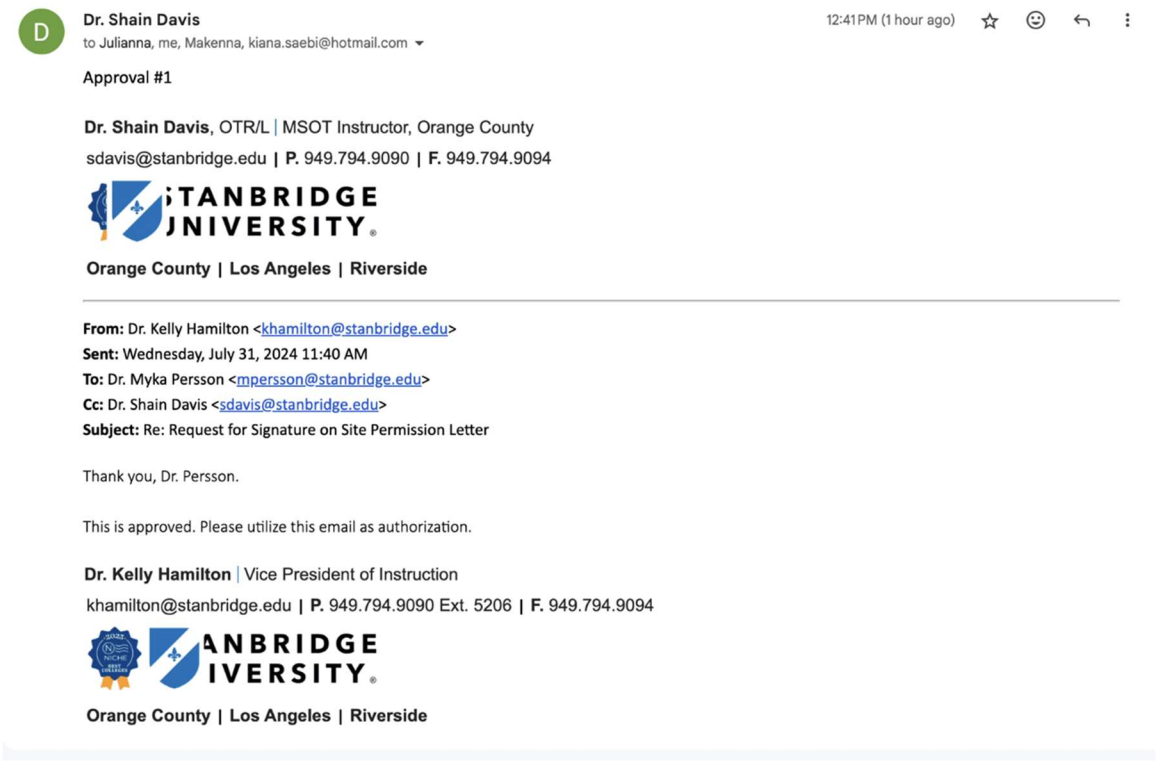
6/27/24

Signature Date

Dr. Kelly Hamilton
Vice President of Instruction, Stanbridge University

Signature Date

STANBRIDGE UNIVERSITY



Dr. Shain Davis 12:41 PM (1 hour ago)
to Julianna, me, Makenna, kiana.saebi@hotmail.com

Approval #1

Dr. Shain Davis, OTR/L | MSOT Instructor, Orange County
sdavis@stanbridge.edu | **P.** 949.794.9090 | **F.** 949.794.9094

STANBRIDGE UNIVERSITY

Orange County | Los Angeles | Riverside

From: Dr. Kelly Hamilton <khamilton@stanbridge.edu>
Sent: Wednesday, July 31, 2024 11:40 AM
To: Dr. Myka Persson <mpersson@stanbridge.edu>
Cc: Dr. Shain Davis <sdavis@stanbridge.edu>
Subject: Re: Request for Signature on Site Permission Letter

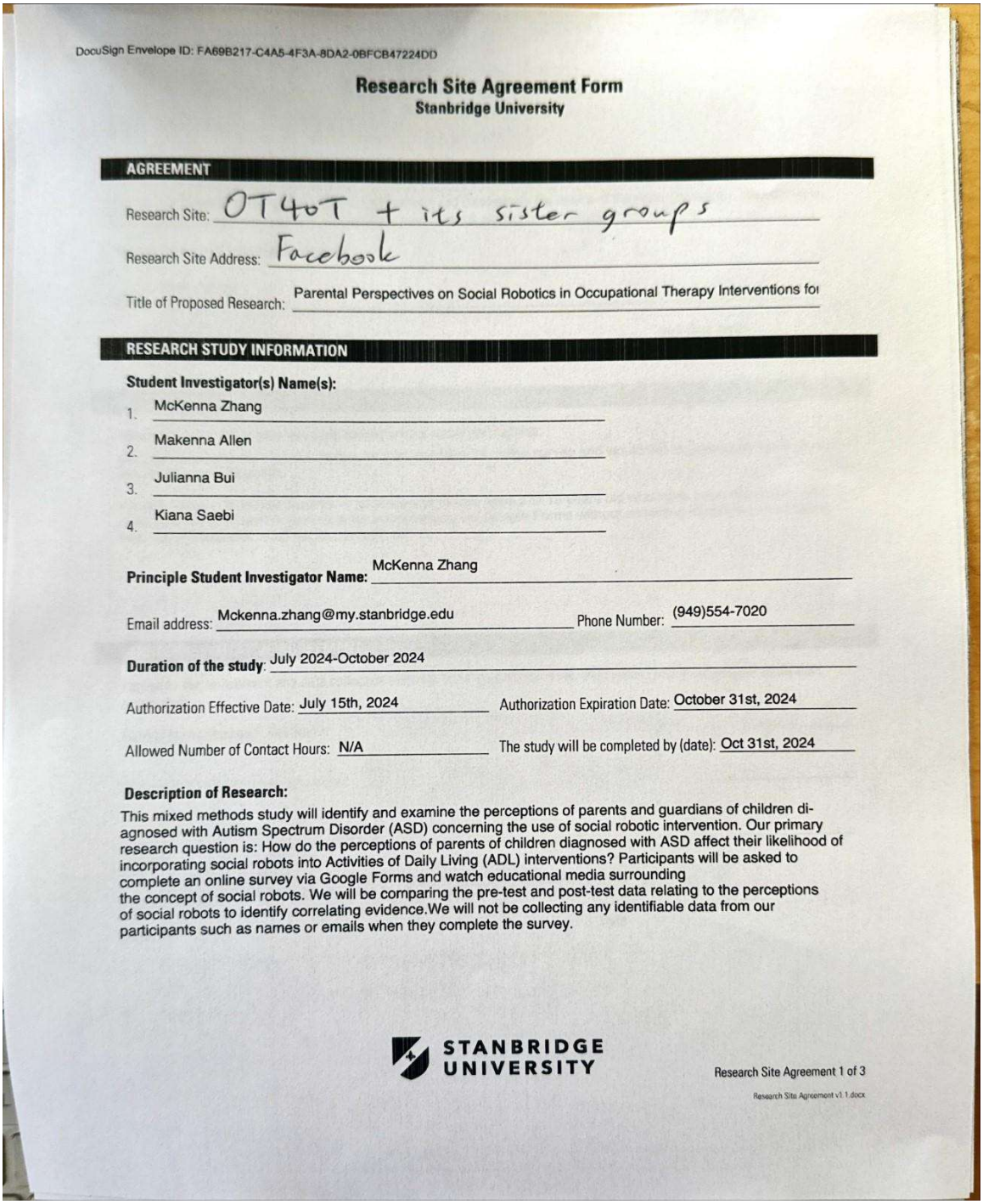
Thank you, Dr. Persson.

This is approved. Please utilize this email as authorization.

Dr. Kelly Hamilton | Vice President of Instruction
khamilton@stanbridge.edu | **P.** 949.794.9090 Ext. 5206 | **F.** 949.794.9094

ANBRIDGE IVERSITY

Orange County | Los Angeles | Riverside



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Research Site Agreement Form
Stanbridge University

AGREEMENT

Research Site: OT4oT + its sister groups

Research Site Address: Facebook

Title of Proposed Research: Parental Perspectives on Social Robotics in Occupational Therapy Interventions for

RESEARCH STUDY INFORMATION

Student Investigator(s) Name(s):

1. McKenna Zhang
2. Makenna Allen
3. Julianna Bui
4. Kiana Saebi

Principle Student Investigator Name: McKenna Zhang

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Research Site Agreement 1 of 3

Research Site Agreement v1.1.docx

Research Site Agreement Form
Stanbridge University

STANBRIDGE UNIVERSITY AGREEMENT SIGNATURES

I/We accept the terms of this agreement.

Student Investigator 1: McKenna Zhang Title: MSOT student
DocuSigned by: Mckenna Zhang F8B43EB1B6724BC...
Signature 6/20/24 Date

Student Investigator 2: Makenna Allen Title: MSOT student
DocuSigned by: Makenna Allen 7C9229D41FBD433...
Signature 6/20/24 Date

Student Investigator 3: Julianna Bui Title: MSOT student
DocuSigned by: 3955C8DF985C4D0...
Signature 6/20/24 Date

Student Investigator 3: Kiana Saebi Title: MSOT student
DocuSigned by: Kiana Saebi EC1C4E44BCEA466...
Signature 6/20/24 Date

Faculty Thesis Advisor: Shain Davis Title: OTD, OTR/L
Signature 6/18/24 Date

Program Director: Myka Persson Title: MSOT PD
Signature 7/3/24 Date

Dr. Kelly Hamilton
Vice President of Instruction, Stanbridge University

Signature Date

STANBRIDGE UNIVERSITY

Research Site Agreement 3 of 3

From: Dr. Kelly Hamilton <khamilton@stanbridge.edu>
Sent: Wednesday, July 31, 2024 11:41 AM
To: Dr. Myka Persson <mpersson@stanbridge.edu>
Subject: Re: Request for Signature on Research Site Agreement for IRB

This is authorized. Thank you!

Dr. Kelly Hamilton | Vice President of Instruction

khamilton@stanbridge.edu | **P.** 949.794.9090 Ext. 5206 | **F.** 949.794.9094

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Appendix C

Survey Form