Clinician Perspectives on Autonomy and Trust in Robots for Pediatric Interventions

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Abstract. Clinicians working with children with motor disabilities can benefit from incorporating robots into clinical practice. However, there is a lack of research on clinicians' perspectives for using robots with different levels of autonomy in these spaces. In this work, we conducted semi-structured interviews with $N = 11$ clinicians, including physical, occupational, and speech language therapists, to understand their unique perspectives and trust levels of using robots in pediatric interventions. The results of our interviews showed that clinicians had minimal experience with robots, but were excited and curious to learn more about the capabilities of a robot. Additionally, clinicians displayed skepticism about trusting a robot with either partial or full autonomy. These key insights from clinicians may shape new design considerations for roboticists in the child-robot interaction space.

1 Introduction

Across the United States alone, approximately 7% of young children experience a developmental disability that impacts motor skills [25]. For young children with motor impairments, practicing and developing motor skills is typically accomplished through therapy interventions with assistive technologies. Common examples of assistive technologies include gait trainers, standers, wheelchairs, adaptive switches, and communication devices [9,13,16]. Assistive robots are a newer, but still uncommon, type of assistive technology used for pediatric therapy interventions. Assistive robots have the potential to provide aid during interventions, such as through direct physical assistance (e.g., exoskeletons) [23,26] or via external motivation and encouragement [10]. For example, robots such as the Lokomat [6] can provide direct physical assistance for a child walking on a treadmill trainer, while other robots, such as the NAO and Dash robots, have been studied as external motivators for encouraging a child in a body-weight support harness to move and play [14]. In our own past work, we developed GoBot [17], shown in Fig. 1, to promote movement for a child using a body-weight support harness and found promising results from an initial pilot study [10]. However, more work remains to enable the translation of robots into clinical practice.

Part of the challenge for encouraging robot adoption is that pediatric healthcare clinicians or caregivers of children may not inherently understand the full capabilities of a robot and how different levels of robot autonomy can be realized.

Fig. 1: GoBot, a custom assistive robot, during interactions with children with motor disabilities.

In the robotics research space, fully autonomous systems tend to be the goal for robots that interact with humans, but the robot's behavior can be unclear and errors are more likely [7]. Further, this fully autonomous behavior is sometimes undesirable for end users, since it can impact user feelings of autonomy and trust. Semi-autonomous and teleoperated systems may increase clinician trust and acceptance, but they also require the clinician to be trained on how to use the robot, in addition to often requiring more direct attention by the clinician during operation [22]. Thus, it is important to consult pediatric healthcare clinicians about their perspectives on using robots in clinical practice or for rehabilitation goals, including how they define and trust a robot with autonomy.

However, most qualitative research related to perspectives of robots for medical interventions have primarily focused on interventions with adult patients or in different domains than physical or occupational therapy. One team of researchers used the Unified Theory of Acceptance and Use of Technology (UTAUT) survey to gather perspectives of clinicians from Colombia and Spain on using robots as a component of rehabilitation therapy with a Lokomat [20]. Extended interviews with adult stroke patients that interacted with a Pepper robot as part of a long-term intervention showed that a social robot can provide emotional and physical benefits during rehabilitative care [15]. In [24], researchers conducted focus groups and interviews with clinicians on using robots for engagement in rehabilitation; this work offered a few guidelines for child-robot interaction but primarily focused on adults. In the domain of robot-assisted feeding, a study showed that patients have no preference for a robot with partial autonomy compared to one with low autonomy [2]. Another work looked at clinician perspectives on using a telepresence robot to reach more patients in an intensive care unit [1]. These works demonstrated the importance of conducting expert interviews in relation to robot autonomy, but clinician perspectives on using robots in pediatric spaces is missing. Thus, our paper builds upon these past works by interviewing pediatric healthcare professionals on the use of assistive robots in clinical settings, an area with minimal work.

Within pediatric rehabilitation, interviews have primarily focused on caregiver or child perspectives related to the use of robots with a minimal focus on pediatric healthcare clinician perspectives. In focus group interviews, caregivers were asked about design features for a robot that helped children to adapt to longer-term hospitalization [12]. The results of the interviews showed that caregivers indicated a preference for more anthropomorphic and mobile robots. Researchers in [4] asked parents about their trust levels for children using exoskeletons, finding that most parents tend to overtrust the functionality and reliability of exoskeletons. A follow-up study analyzing both parent and clinician perspectives on the use of pediatric exoskeletons found (perhaps alarmingly) that parents trusted the technology more than clinicians [3]. Child and parent pairs were asked questions in semi-structured interviews about interacting with a socially assistive robot during pediatric rehabilitation in another project [5]. However, clinicians' experiences and perspectives on using robots with children with motor disabilities is lacking; this work bridges the gap through semi-structured interviews with pediatric healthcare professionals.

In this paper, our key research goal was to *gather and analyze clinician perspectives on robot autonomy and trust as a component of pediatric rehabilitation*. We conducted semi-structured interviews with $N = 11$ pediatric healthcare clinicians including physical therapists (PT), occupational therapists (OT), and speech language pathologists (SLP) who work with children with motor impairments to address our goal. We first describe the methods of our interviews with clinicians in Section 2. The results from our coding appear in Section 3. Section 4 discusses the implications of our findings and offer guidelines for collaborative robot design in motor interventions. The main contribution of this paper is valuable insights into pediatric healthcare professionals' perspectives on the features, autonomy, and clinician trust of assistive robots used with children with motor disabilities for pediatric rehabilitation.

2 Methods

We conducted the interviews in 2022 using a qualitative phenomenological framework to understand pediatric healthcare clinicians' experiences with robots and perspectives on use in clinical practice. The interviews were part of a larger study that aimed to 1) explore and describe therapists' experiences and perceived benefits of toys for young children with disabilities and 2) explore and describe therapists' experiences and perceived barriers to selecting and utilizing toys for young children with disabilities. This paper focuses only on the robot portion of the full interview data. The study was approved through the Oregon State University Institutional Review Board.

2.1 Procedure

We first collected demographic data through a survey that participants completed on Qualtrics. The demographics survey collected participant age, gender, ethnicity, race, practice discipline, years of experience, and the typical population they see in clinical practice. We then conducted the semi-structured interviews over Zoom, and each interview was recorded in its entirety for later transcription.

The same researcher conducted each interview; these interviews took approximately 20-50 minutes to complete. We asked questions that requested healthcare clinicians' perspectives on if toys are a part of their scope of practice, their experience with toys when working with children and families, perceptions of family and child experiences with toys, their perceptions of toy companies and societal inequities, their experience with working with robots in clinical settings, and their understanding of robotic features and autonomy. This paper focuses only on the robot portion of the interview data. We first asked participants if they had experience working with robots or other assistive technologies in a clinical or pediatric setting. We then asked them about their general feelings towards using robots in clinical practice, features they would want in a robot, and barriers to using robots.

Participants were then asked to define the term autonomous and then verbally presented with the following six types of technologies: S1) treadmill with a stop sensor, S2) smart walker or smart wheelchair, S3) car with cruise control, S4) robot that you teleoperate completely, S5) robot whose wheelbase drives automatically, but whose other interactive features you control, and S6) robot whose wheelbase and other interactive features operate automatically. We asked participants if each of the technologies were autonomous and if they would trust a robot in the final three scenarios (S4, S5, and S6). We crafted the final three scenarios to align with general robotics definitions of teleoperated, semi-autonomous, and fully-autonomous robots, respectively.

2.2 Participants

The participants in this study included pediatric healthcare professionals spanning PT, OT, SLP, and developmental pediatricians. We used the following inclusion criteria for selecting participants: 1) practices in the state of Oregon or SW Washington, 2) has prior experience working with children with medical complexities, and 3) has prior familiarity with any assistive technology. Participants were recruited through email, flyers, and social media. We collected informed consent for each participant before involvement in any study activities and we compensated clinicians $15 at the end of the study.

2.3 Analysis

Following the completion of the interviews, audio recordings were first transcribed using Whisper AI, an open-source speech recognition tool [19]. A trained transcriber reviewed the transcript and fixed any transcription errors for each participant's data prior to coding. Two coders participated in a training session prior to coding the transcriptions. The two coders coded the transcription data using a constant comparison method [8] with an *open coding* phase and a *focused coding* phase. The coders reviewed each clinician's transcript until data saturation was achieved and themes emerged from the data [21].

In the *open coding* phase, we reviewed the raw qualitative data and flagged quotes describing features of robots or issues related to using robots for further review. The coders reviewed the flagged quotes and other related observations

Table 1: Participant demographics, including age, discipline, years of clinical experience, and any previous experience with robots.

Participant	Age (yrs)	Discipline	Experience (yrs)	Robot Experience
P1	62	Physical Therapist	>20	Yes
P2	34	Physical Therapist	6-10	Yes
P3	39	Occupational Therapist	11-15	No
P4	52	Developmental Pediatrician	16-20	Yes
P5	35	Speech Language Pathologist	11-15	No
P6	63	Occupational Therapist	>20	No
P7	31	Physical Therapist	2-5	No
P8	36	Physical Therapist	11-15	No
P9	47	Occupational Therapist	>20	No
P10	54	Physical Therapist	>20	No
P11	50	Occupational Therapist	>20	No

during the *focused coding* phase to create an initial set of categories. After further review, similar categories were integrated into broader themes. The coders met during each step of the coding procedure to participate in reflective discussion and review of the emerging results. The end result of this process was seven main themes that primarily shape our results. We include quotes and descriptions from participants that align with each theme.

3 Results

11 participants (10 female, 1 male) completed the study. Participant ages ranged from 31-62 years ($M = 45.7$, $SD = 11.4$), and all identified as White. Full demographic information can be seen in Table 1. We describe the seven main themes that emerged from the coding process (one per subheading) below.

3.1 Clinicians have limited experience with robots

We found that only three of the 11 clinicians had prior experience with robots of any kind. All three clinicians that had experience with robots used them to encourage mobility through different types of games or to improve hand function by controlling the robot. P1 noted "We were doing drag races in the hallway. We played hide and seek with the robots, with a child who's been working on independent mobility skills." P2 observed that "[the children] will drive their powered mobility car around to chase the robot in the hallway, or [the child] will walk across in the gait trainer to get to [the robot] because it is there and it's more motivating than anything else I have." All the clinicians who did not have prior experience with robots indicated that they routinely used assistive technologies, such as iPad tablets or augmentative and alternative communication (AAC) devices, in their practice.

3.2 Clinicians are open and curious to learn about the possibilities of robots

Clinicians generally felt open towards incorporating robots into pediatric interventions regardless of having prior experience with a robot. All 11 clinicians indicated an openness and curiosity towards using robots in clinical practice. P6 compared incorporating robots to the release of the Nintendo Wii [18]: "I think I'm all for it. I think there was a time when [the] Wii came out so there was a lot of use of that in rehab facilities working on you know just different skills. [I am] into the idea of using robots, especially in specific circumstances." Although each clinician was interested in using robots, at least two noted some hesitations or need for further information before accepting a robot into clinical practice. P1 mentioned an initial concern over using robots: "I was actually a little concerned, especially with [the robot], that a certain percentage of the kids would be afraid of [the robot], but that has not seemed to be the case." P9, an OT, expounded that errors may hinder usage of a robot: "I feel like as long as I felt trained and I knew what I was doing, because that's the one thing that probably intimidates or frustrates me the most. If something goes wrong, we usually don't know how to fix it." These hesitations as well as the overall interest for using robots fed directly into clinicians' desired robot features.

3.3 Parental involvement is expected

All 11 clinicians noted that they would feel more comfortable with a robot if a parent was also in the room. Clinicians noted that parents are typically involved in every session with the child and that a robot could interact or be controlled by a parent. P8 noted that "I wouldn't do anything without [the parents] there," while P9 added "I feel like most everything I do, I'm more comfortable with parents present."

3.4 Clinicians desired robots to be easy to use, durable, child-friendly and have a meaningful purpose

P1 said that "I think one thing is that [the robot] is easy to use. You know, it's not complicated? It has to be really durable. I feel bad cause I keep breaking [the robot]. And it's not that I do it on purpose." P1 also mentioned that a robot should "not overwhelm the therapist with all the options." P5 added that the main feature they wanted in a robot was "simplicity."

Clinicians described a robot as needing to be child-friendly in different terms. P10 described a child-friendly robot as: "I think if you could program it to respond to specific noises that a youth might make. If you could teach him that a grunt makes the robot come. Or if they make an open vowel sound, it makes the robot sit. So you're pairing the play with something that they're able to do. That'd be kind of cool." P3 and P5, both occupational therapists, mentioned that a robot should "not look scary," and P8 added that a robot should be "quiet, I think a lot of kids are freaked out by, especially if they have visual impairment, the sounds."

Multiple clinicians indicated specific purposes for a robot in clinical settings. For example, P3 wanted a robot that could "write notes" or a robot that could "reach the top of the toy closet" or even a robot that could "use the mop to clean the gym." P8 desired a robot that was "able to interface with a communication device." P2, who had some prior robot experience, gave many different types of potential functions for a robot: "So obviously if this robot is [for] play, but also more focused on movement, then the robot should move or engage with the child. Like, the child moves and then the robot does something. We can work on our actual therapy movements and the robot is engaging with them through that, I think would be cool. If we're actually talking more about a robot that's doing play, then the robot maybe doesn't have to be as mobile; it can stay in one spot, and [if] the child puts a ball in [the robot], it automatically rolls the ball back out to them."

3.5 There is an overall need for more education of clinicians

Despite the multitude of different robot features that clinicians desired, a majority of the clinicians also expressed uncertainty about what robots are capable of or how accessible a robot can be for clinical practice. P11 said that "I don't know enough about robots probably. So, I can't really envision anything, but that doesn't mean it's not possible," while P3 noted that "I don't really know. I think because I don't even know the possibilities of where to start, but you know, part of me is saying [a robot should] have all these different options, but I think the more complex it gets the more likely it is to have some challenges." Clinicians also elaborated on uncertainties for the price of a robot for clinical practice and how accessible the technologies may be for smaller clinics with fewer resources. P1 mentioned that "I think there are already robots that exist that do some of the repetitive gait-training and stepping sort of mechanics that would be helpful, but we just don't have the capacity to afford them." As described more later, these uncertainties impacted how much clinicians would trust a robot.

3.6 Clinicians have limited understanding of robot autonomy

We found that clinicians defined autonomy in different ways, including in terms of human autonomy rather than robot autonomy. P11 said autonomous is being "independent, or self-managing," while P9 defined autonomous as "I feel like [autonomous] means that you have power in decision-making around what is going to happen to your person." When describing autonomy in terms of a robot, clinicians tended to focus on a robot moving itself. As P8 noted, an autonomous robot is "self-driven. It doesn't require manual input, but is self-driven by itself." P4 said that an autonomous robot has "independent moving, independent functioning, and responding directly to environmental stimuli as opposed to needing to be operated remotely."

After they defined the term autonomous, we asked each clinician to decide if different types of technology were autonomous or not. As a reference, the list of scenarios can be seen in Section 2.1. P10 did not complete the answers to each scenario, and P3 answered unsure for each scenario. Two of the 11 clinicians (P4 and P5) answered that a treadmill with a stop sensor (S1) was autonomous. P4 and P5 also said that a smart walker (S2) was autonomous while P1 and P2 said maybe. Three participants (P1, P5, and P9) identified cruise control technology (S3) as autonomous while P2 observed that "[cruise control] is an autonomous feature, but it's not an autonomous whole system." None of the participants identified a teleoperated robot (S4) as autonomous while seven clinicians said that a semi-autonomous robot (S5) was autonomous. P2 described

S5 as a robot having partial autonomy. Each participant that completed the scenarios answered that a fully autonomous robot (S6) was autonomous.

3.7 Clinicians have limited trust of robots with different levels of autonomy

Building upon the clinicians' answers to levels of robot autonomy. we asked the participants if they would trust a robot in the final three scenarios (S4, S5, and S6). P10 did not complete the answers to each scenario and P3 answered unsure for each scenario. We found that only five of the clinicians would trust a teleoperated robot (S4). P1 said they would not trust a teleoperated robot partially because "I might tell [the robot] to do something dumb and then it would do it." P4 expressed a similar reasoning for not fully trusting a robot: "You can hit the wrong button, and people can do unpredictable things around the robot." Only two clinicians (P8, P9) said they would trust a semi-autonomous robot (S5) while two other clinicians (P2, P6) said they would trust the robot only after learning and practicing with the system. P1 noted a tendency for skepticism with robots: "I would never completely 100% trust a robot, but I would never completely 100% trust myself either." The six other clinicians said they would not fully trust a semi-autonomous robot. For the final scenario, only P4 and P9 said they would trust the robot. P8 noted that they would trust a fully autonomous robot after further understanding how the system worked: "[the robot] is probably sensing the environment, which is why it's able to drive automatically, it's looking out for obstacles and things like that. So if I knew [the robot] was able to do those functions, I think I would trust it. " P3 offered concern over the effectiveness of how a robot moves autonomously without collisions: "I think I would be more concerned about the [robot] drive features rather than the [robot] reward features." Each of the other seven clinicians said they would either be skeptical or not trusting of a fully autonomous robot.

4 Discussion

The results of our semi-structured interviews show broadly that pediatric healthcare professionals have little experience with robots, but are interested in incorporating them as a component of clinical practice. For successful robot integration in the clinic space, clinicians should be included in every step of the design process. Clinicians unanimously expressed that parents are a constant component of sessions, so robots should also encourage parental involvement. We saw that clinicians had a range of desired features for a robot, but also were unsure of what a robot was capable of and how accessible a robot could be. Roboticists developing robots for child-robot interaction in pediatric interventions should design robots that are simple to use and focused on assisting in meaningful tasks for the child. Additionally, roboticists need to provide more detailed training for clinicians on what features a robot has and how to activate those features. We found that clinicians often define autonomy in terms of the child they are working with; one of the primary goals of physical, occupational, or speech language therapy is increasing a child's independence [11]. When explaining autonomy to a clinician, it is important to consider how clinicians may think of autonomy differently than roboticists. While each clinician agreed that a teleoperated robot was not autonomous and that a fully autonomous robot was autonomous, answers varied for a semi-autonomous robot. We propose that roboticists need to clearly outline what level of autonomy a robot will have and what features the clinicians has control over. Finally, clinicians are skeptical of trusting a robot, regardless of the level of autonomy. We suggest that a robot's autonomy should always be easily overriden by a clinician, and that roboticists allow a clinician to practice with the robot before use with children.

Key *strengths* of this paper include the gathering of clinician perspectives on robots for pediatric interventions, an area that has seen less focus than interviews with children or adult caregivers. We showed how clinicians are excited by the prospects of robots, but remain skeptical and desire further education on robot capabilities. A *limitation* of this work is the small sample size and lack of diversity and gender balance in the population sample; we only collected opinions from 11 White clinicians in the Pacific Northwest of the United States, and the majority of clinicians were female. Future work should expand the diversity, geographic region, and gender balance of clinicians interviewed.

Acknowledgments

We thank Thalia Clow and Lucas Yao for help in transcribing the interviews.

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