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# Overtrust of Pediatric Health-Care Robots

## A Preliminary Survey of Parent Perspectives

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Numerous types of robots are being interwoven into the health-care system, including rehabilitative devices for use with pediatric populations. Yet a key ethical concern is that pediatric patients, their parents, and other caregivers might begin to overtrust robotic technology, possibly resulting in a patient being harmed or the technology adopted prematurely. To gain insight into the issue, our research team conducted a study examining the potential of overtrust in pediatric robotics. This article discusses results from a survey of parents who have at least one child with a movement disability. The survey's focus is on robotic exoskeletons, which represent the most viable of the currently available robotic technologies in terms of being adopted into the home as a clinically validated rehabilitative device for both adults and children. More than 62% of respondents indicated they would typically or completely trust their child to handle risky situations with an exoskeleton, even though the technology may not be designed for such situations. We conclude with suggestions for future research directions on the problem of overtrust in health-care robotics.

### Robots in the U.S. Health-Care System

Robots are being introduced into the U.S. health-care system with growing frequency [1]. From surgical robotic systems to medication delivery devices, medical services are being transformed through the integration of diverse intelligent agents and platforms. Robotic rehabilitative devices, including those used with pediatric populations, are also gaining traction. The primary intent of such robots is to improve the quality of life for children. However, a key ethical concern with their use in pediatric health-care settings is the prospect that children, their parents, and other caregivers might begin to overtrust the

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technology. This concern stems from studies indicating that placing too much trust in automated health-care systems may result in unintended negative consequences. For example, when physicians overtrust automated systems for detecting cancer, certain types of the disease may be overlooked [2]. In fact, a systematic review of clinical support systems discusses the potential overreliance on automated health-care systems and how the occasional incorrect advice derived from these systems may cause expert users to reverse their decisions [3].

In the context of health-care robotics, individuals may be granted access to the technology before they have had sufficient training or a clear understanding of its capabilities. This could result in improper usage or a premature adoption of the technology. Based on the growing use of robots for health-care-related applications, an exploration of the implications and potential for overtrust within health-care settings may be necessary to mitigate or prevent possible negative effects. In response to the growing concern that patients, caregivers, and medical professionals may place too much trust in health-care robots, we conducted a survey on overtrust as it relates to pediatric robotics.

## Background on Overtrust

Lee and See state that "overtrust is poor calibration in which trust exceeds system capabilities" [4]. This description of overtrust is the starting point for any research in this area. Lee and See focused on factory automation, in which case overtrust may lead to assembly breakdowns. The person overtrusting the system is rarely in any real danger. Our augmentation of this definition is meant to address the differences found when involving robots versus automation. Robots can and do put people at risk of physical injury. Hence, not only does overtrust reflect poor calibration, in which trust exceeds system capabilities, but it also results in a form of misuse that may place the user at increased risk. This extension combines Lee and See's definition of overtrust with Parasuraman and Riley's examination of how overtrust leads to misuse, which puts the user at risk [5]. Although Lee and See focused on trust in automation, their article has been foundational for the study of trust calibration in the domain of robotics.

In the context of robotics, this definition of *overtrust* specifically describes a situation in which a person accepts risk because it is believed that a robot can perform a function it cannot or the person accepts too much risk because the expectation is that the robot will mitigate the risk [6]. An example of the first case would be parents who allow their child to climb a jungle gym while wearing a robotic exoskeleton with the expectation that the exoskeleton would protect the child from a fall, even though it lacks that functionality. The second case, where the person accepts too much risk, could involve patients becoming prone to overexerting themselves because they feel the robotic rehabilitative device they are wearing has repaired or replaced a lost ability. Overtrust is often described in the literature as occurring when one's trust is miscalibrated, which can result in the misuse of a technology and increased risk [4].

Vulnerable populations, such as children with acquired or developmental disorders, are particularly susceptible to the risks posed by overtrust [7]–[8]. Generally speaking, children cannot adequately assess the hazards of using complex technological devices [9]–[10]. Conjoining this with the observation that children, especially teenagers, are at a risk-seeking stage of life, the chance of harm intensifies. As such, children may seek to test the limits of a robotic device's safety features or even actively try to misuse the device.

Complicating the issue is that parents or other caregivers may not fully identify the risks associated with using a robotic device, especially within environments such as the home or at school. This could occur, e.g., because parents are too preoccupied or emotionally invested in the technology as a potential treatment [11]–[13]. For instance, parents may place too much trust in a humanoid robot that instructs their child on how to perform a rehabilitation exercise, allowing the robot to decide their child's routine even if there are signs of distress. Parents or other caregivers might falsely believe that a robot is better at detecting when to end a therapy session [14]–[15]. Moreover, parents of a child suffering from a chronic disease or impairment may select a robotic device despite the availability of equivalent or even superior treatment options simply because they perceive the robot as being better. If robotic devices are erroneously perceived as being more trustworthy than other options, then the amount of attention parents dedicate to monitoring their child's treatment plan may decline.

## Exoskeleton Overview

The introduction of robotic technology can significantly impact a range of stakeholders, including health-care providers, parents, and patients. Much attention is focused on robotic exoskeletons, a type of wearable robot, because they could provide more mobility and other forms of freedom to a variety of populations, including pediatric patients (e.g., see Figure 1). A robotic exoskeleton can contain a powered series of actuated devices that respond to a person's intended motions and can provide additional motion assistance and support. The device is harnessed to the person's body and can be used to assist with upper and lower neuromuscular rehabilitation.

Exoskeletons are rapidly developing and being released to the public. For example, in Japan, companies are offering exoskeletons for use in the home [16]. The Cyberdyne Corporation, for example, rents its Hybrid Assistive Limb (HAL) exoskeleton and actively promotes its use for children with disabilities [17]. Recently, exoskeletons have been created for small children and infants [18]. Well-designed systems can clearly have important benefits. Yet it is critical to study the evolving nature of the human-robot trust relationship, especially considering that not all exoskeleton users may be receiving proper training.

In the rehabilitation domain, roboticists have been developing a range of robotic systems designed to interact with children [19]–[21]. Many systems are intended to enhance

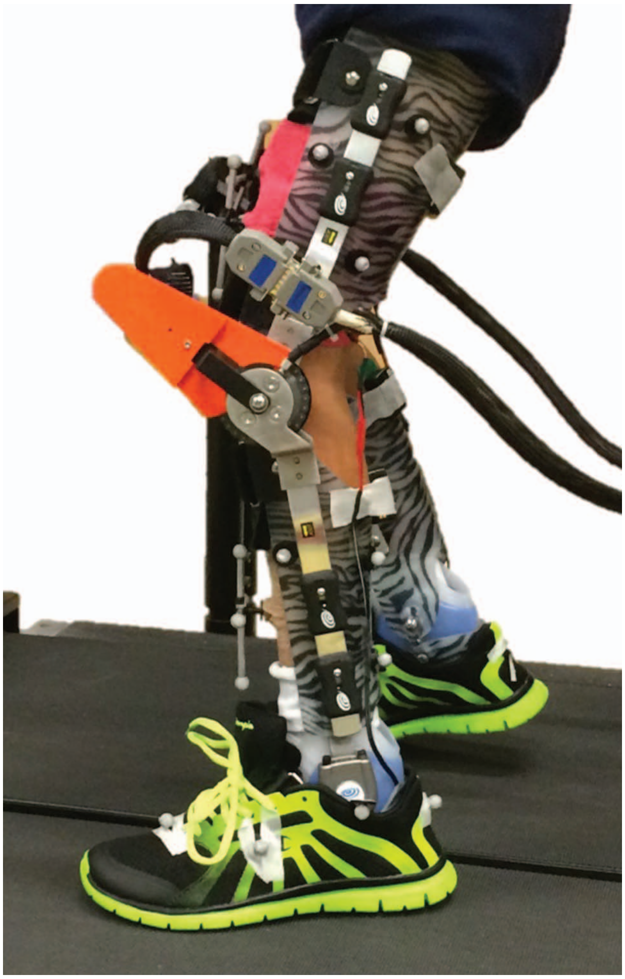

**Figure 1.** A robotic exoskeleton for children. (Photo courtesy of the Department of Rehabilitation Medicine, National Institutes of Health Clinical Center.)

therapy opportunities for children with neurological and developmental disorders. Those who have limitations in their upper and/or lower extremities can receive therapeutic interventions through wearable robots, such as exoskeletons, robotic arm orthosis, and robotic-assisted locomotor trainers. For example, Tyromotion's Amadeo uses robotic-assisted devices to provide arm and hand rehabilitation for children through interactive virtual reality games [22]. Virtual reality approaches have also been coupled with the Motek Gait Real-Time Analysis Interactive Lab system to enable gait training for children [23]. Other devices such as a robotic ankle orthosis [24] and robot-gait assisted training [25] have also shown promise in assisting children with neurological disorders.

Exoskeletons have additional uses beyond therapy. For example, lower-extremity exoskeletons can be used for human locomotion assistance, i.e., assisted walking in natural environments. Of the subset of commercially available devices, the most common are the ReWalk exoskeletons, the Ekso GT wearable exoskeleton, and Cyberdyne's HAL. The ReWalk exoskeleton is noted as the first exoskeleton suit cleared by the U.S. Food and Drug Administration (FDA) to be used as a personal device in the home and elsewhere [26]. The ReWalk Personal System has been recorded as enabling a user to move 0.7 m/s, which is currently the fastest exoskeleton-assisted walking speed [27]. To provide context, the average human walking speed is approximately 1.4 m. However, ReWalk Rehabilitation is designed for use in the clinical setting. The Ekso GT has FDA clearance and is noted as a wearable exoskeleton device for gait therapy [28]. Cyberdyne has both a medical HAL that is certified under the Medical Device Directives in the European Union and a nonmedical HAL that can be used for autonomous motion assistance [29].

The creators of the ReWalk state that the intent of the technology is to enable individuals to "stand upright, walk, turn, and climb and descend stairs" although the stair function is not available in the United States [26]. Cyberdyne claims its device can assist individuals with walking, standing up, or sitting down by themselves, but stair climbing (ascent or descent) is not directly mentioned [29]. Ekso Bionics explicitly warns that "the devices are not intended for sports or stair climbing" [30]. Given the advances in the technology and its use in an increasing number and variety of contexts, it is important to examine perceptions of the technology's trustworthiness. In the following section, we describe our methodology for investigating human–robot trust in the pediatric health-care domain. The study results, reviewed in the "Discussion" section, indicate there is significant potential for overtrust.

## Methods

As a first step in investigating the overtrust of health-care robots, we conducted a survey by interviewing the parents of children who have any form of disability that affects movement, muscle control, and/or balance. The intent was to characterize the types of risks that parents are willing to accept when their child is wearing a robotic exoskeleton. Robotic exoskeletons may shed light on the use of health-care robots in general.

Our survey consisted of 25 questions (plus one additional question that gauged whether the participant was paying attention). Before administering the survey, we sent it to a small group of scholars who were unaffiliated with the project to check the appropriateness of the questions and for readability. The survey took approximately 10 min to complete and contained a combination of multiple-choice questions, open-answer questions, and demographic questions (see Table 1). A five-point Likert-scale was used for the multiple-choice questions, in which only one option could be selected from a defined list of choices; other questions allowed respondents to select multiple answers from a list of options. The Georgia Tech Institutional Review Board approved the study in the exempt review category. Our recruitment strategy involved placing an advertisement on a number of Facebook group pages focused on either assistive technologies, special-education technology, or parent support groups of children with special needs. If the parents had

Table 1. Survey questions—Trust me but not too much: Balancing risk and trust in rehabilitation robots.

| Question Type | Question |
|---|---|
| Multiple-choice questions | How many children do you have? |
| | How many of your children have a disability that affects movement, muscle control, and/or balance? |
| | What are the ages and genders of your children who have a disability that affects movement, muscle control, and/or balance? |
| | Compared with other children, how adventurous or cautious is your child? |
| | A robotic exoskeleton is a wearable machine covering the arms or legs that can assist the user with walking or other types of movements. Has your child ever used a robotic exoskeleton before? |
| | How much trust would you have in your child to handle a risky situation, such as climbing stairs, if he/she were wearing a robotic exoskeleton? |
| | If your child encountered a risky situation while wearing a robotic exoskeleton, who should be notified first? |
| | If your child encountered a risky situation while wearing a robotic exoskeleton, what would be the best way for the device to notify or protect the child? |
| | If your child encountered a risky situation while wearing a robotic exoskeleton, what would be the best way to notify you? |
| | In the future, where would you want your child to be able to use a robotic exoskeleton? |
| | Which types of activities do you think your child would try to perform while using a robotic exoskeleton? |
| | How comfortable are you with using computing technology such as a mobile phone or a personal computer? |
| | How comfortable would you be with using a new advanced technology, such as a robotic device, that you have not used before? |
| | How often have you interacted with robots (for example, a robotic vacuum)? |
| Open-Ended questions | What is your biggest concern about what your child might try to do while wearing a robotic exoskeleton? |
| | What is your biggest concern about what might happen to your child while wearing a robotic exoskeleton? |
| | Do you have any additional comments about how your child might interact with a robotic exoskeleton? |
| | If you have had any prior experience with robots (e.g., a robotic vacuum), please describe below. |
| Demographic questions | Please indicate your age. |
| | Please indicate your gender. |
| | What is your race/ethnicity? |
| | What is your highest level of education completed? |
| | What is your primary occupation? |
| | What is your native or preferred language? |
| | In which state do you currently reside? If you normally live outside the United States, indicate which country. |

more than one child with a movement disability, then they were asked to answer based on the oldest of those children. The respondents had the option to skip any question they did not want to answer.

The survey was administered online using Qualtrics on 18 and 19 January 2017; a sufficient number of responses was received within the relatively short timeframe of two days. This was a surprising occurrence since our initial expectation was that data collection would take weeks to reach the target sample size. It is difficult to determine the explanation for the rapid data collection period, but it may be attributable to the power of social media and long-term connections to established networks of parent support groups on the Internet. Data were obtained from caregivers who had experience with assistive technology and children with special needs. At this stage of the research, we wanted to avoid collecting data from a pool of subjects with no experience in these areas because their responses to the questions would have been hypothetical and disconnected from real experiences with assistive technology. Our choice of subject population obviously limits the generality of our results to the recruited subject population.

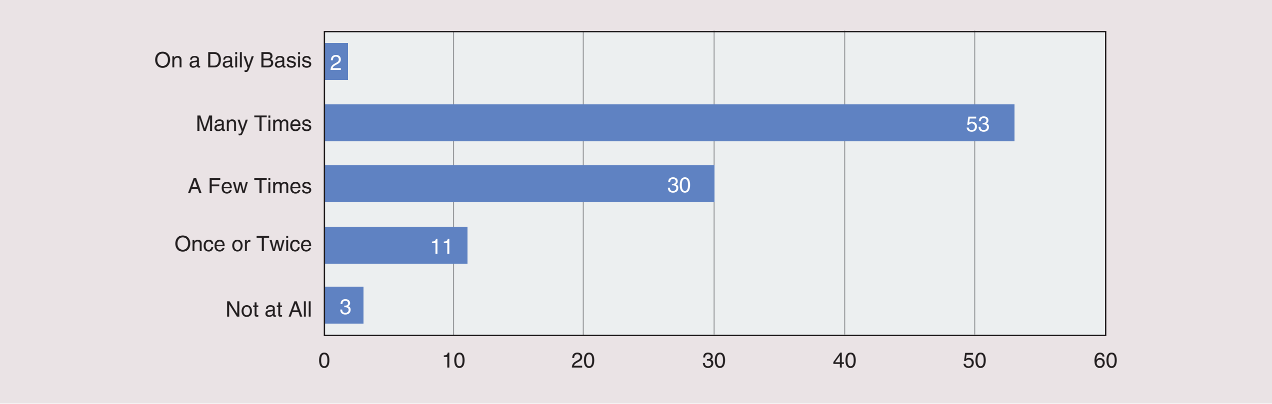

**Figure 2.** Responses (indicated in percentages) related to the participants' prior experiences with robots.

## Results

### *Demographics of Survey Respondents*

A total of 108 people entered the survey portal. After applying our inclusion criteria, including that respondents had to report having at least one child, we received 97 respondents in total, 72 male and 24 female (one did not respond to this question item). The population was fairly diverse; approximately 45% of the respondents were white, 37% Hispanic or Latino, 14% black or African American, 2% native Hawaiian or other Pacific Islander, 1% Asian, and 1% American Indian or Alaska native. In terms of their education, approximately 66% of the respondents had a master's degree or other advanced graduate degree. The age range of the parents was 21–56; the mean age was approximately 36.5 years.

There were 94 respondents who answered a survey question about their home state. Approximately 12% of the respondents were from the Northeast, 34% were from the South, 11% from the Midwest, and 43% from the West. For all but two of the respondents who indicated Spanish, the native or preferred language was English.

> Based on the responses, the majority of participants were either comfortable or very comfortable with technology and had prior experience with some form of robotic device.

For the question item "How comfortable are you with using computing technology such as a mobile phone or a personal computer?," approximately 27% indicated "very comfortable," 65% indicated "somewhat comfortable," 4% were "neutral," and 3% were "somewhat uncomfortable." Zero respondents indicated "very uncomfortable." Regarding "How comfortable would you be with using a new advanced technology, such as a robotic device, that you have not used before?," approximately 52% indicated "very comfortable," 31% indicated "somewhat comfortable," 8% were "neutral," 7% were "somewhat uncomfortable," and 1% were "very uncomfortable." For the item "How often have you interacted with robots (e.g., a robotic vacuum)?," 2% indicated "on a daily basis," 53% "many times," 30% "a few times," 11% "once or twice," and 3% "not at all" (see Figure 2).

Based on the responses, the majority of participants were either comfortable or very comfortable with technology and had prior experience with some form of robotic device. The surveys do not directly capture how much of this experience is with exoskeletons. It is unlikely, however, that children and their parents would interact with an exoskeleton on a daily basis even if using the technology in a clinical setting. Access to these robots is expensive, and time spent in training is physically demanding for the patient. Hence, only weekly or biweekly sessions with an exoskeleton are to be expected.

### *Demographics of Children and Perceptions on Child–Robot Interactions*

Participants were asked to provide demographic information about their children and their perspectives on the behaviors their children might display when interacting with a robotic exoskeleton. All included participants reported having at least one child with some form of movement disability. In terms of gender of the included child population, 59 of the children were male, and 41 were female (four of the parents had more than one child with a disability). The youngest child was one and the oldest was 22. The average age was just under 9 years old (8.87). We did not directly include a statement in the survey about the age range of a child, so some of the children mentioned by the survey respondents are older than the legal definition of a child. Four of the children discussed by the caregivers were 18 or older.

The respondents were asked where they thought their children might want to wear an exoskeleton and were given a "check all that apply" option: 77 indicated at school, 57 in outdoor settings, 48 at home, 45 in a hospital or health-care setting, and two indicated "other" (with one saying "Any time he is among peers") (Figure 3). Since respondents could select more than one choice for this question item, the number of

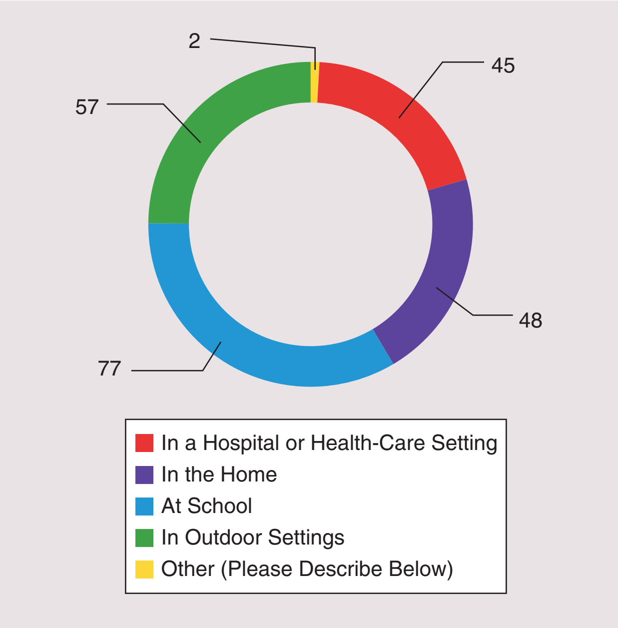

**Figure 3.** Responses related to the desired locations for exoskeleton use by a child.

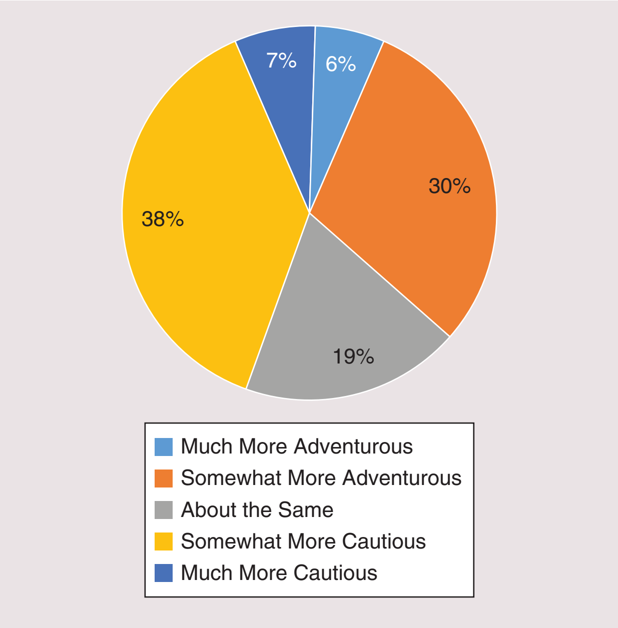

**Figure 4.** The adventurous nature of children with a movement disability.

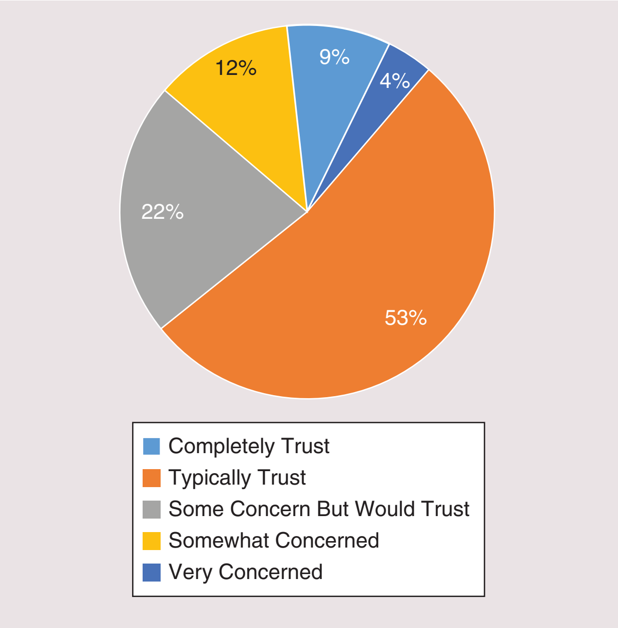

**Figure 5.** Trust in children with a movement disability.

respondents (rather than the percentage of respondents) is listed here and in Figure 3. Seventy-five percent of the respondents indicated that their child had prior experience with a robotic exoskeleton. To provide context, we supplied a hyperlink to an image of a sample exoskeleton (the image used in the survey can be found at: https://www.choa.org/~/media/images/Childrens/photo-galleries/medical-services/rehabilitation/center-adv-tech/ekso-robotic-exoskeleton.png). In response to “Which types of activities do you think your child would try to perform while using a robotic exoskeleton (check all that apply)?,” 83 respondents indicated “walk,” 59 indicated “run,” 27 indicated “climb,” and 16 indicated “jump.” Since the respondents could select more than one choice for this question item, the number of respondents (rather than the percentage of respondents) is listed here.

In response to the question “As compared to other children, how adventurous or cautious is your child?,” approximately 6% of the respondents indicated “much more adventurous,” 30% said “somewhat more adventurous,” 19% indicated “about the same,” 38% answered “somewhat more cautious,” and 7% said “much more cautious” (Figure 4). In response to the question “How much trust would you have in your child to handle a risky situation, such as climbing stairs, if he/she were wearing a robotic exoskeleton?,” approximately 4% of respondents indicated that they would be “very concerned,” 12% said “somewhat concerned,” 22% had “some concern but I also would trust my child,” 53% indicated they “would typically trust my child to handle the situation,” and 9% would “completely trust my child” (Figure 5). Although the phrasing of the question more directly asks about the trust parents would place in their child rather than in the technology, the resulting information suggests how parents view the resulting actions of the child/machine system. The data suggest that parents may accept greater risks when they consider the child and machine together rather than just the child alone. This information can provide some guidance in terms of considering safety features; in other words, parents may need reminders not to leave their child unattended while using an exoskeleton.

The survey also posed questions to the caregivers about safety-related notifications. These questions were primarily designed to assess possible interfaces that could enhance the interactions among parents, children, and robots. In terms of who should be notified first if the child were to encounter a risky situation, approximately 48% of respondents indicated it should be them (i.e., the parent or guardian), 41% indicated the child should be warned first, 7% selected the child's other parent or guardian, 2% indicated "another relative or friend of the child," and 2% stated "my child's physician or other health-care provider." The fairly divided split here between warning the parent first versus warning the user (i.e., the child) indicates that the design pathway roboticists use with respect to safety considerations needs to be investigated more fully. One option to consider is allowing parents to toggle the warning system depending on their preferences.

**Robots are beginning to play a role in the physical rehabilitation of children, making it essential to understand how their use could change or increase the risks faced by pediatric patients.**

In terms of the best method of notifying the child wearing an exoskeleton if a risky situation emerges, approximately 32% of respondents suggested an audio warning, 34% indicated a visual warning, 14% indicated that the device should vibrate, 6% indicated that the device should slow down, and 14% indicated that the device should stop working. Of course, the parents' expressed preferences are likely contingent on the physical and mental capabilities of their children.

In terms of the best method of notifying the parents if their child encounters a risky situation, approximately 8% wanted the health-care provider to inform them, 30% indicated that the robot should have an audio warning, 16% indicated that the robot should have a visual warning, and 46% indicated that their phones should receive a call or a text message. A fairly large divide is seen here in terms of what design pathway parents would recommend to roboticists.

The survey also included a few open-response questions (see Table 1). Reacting to "What is your biggest concern about what your child might try to do while wearing a robotic exoskeleton?," most parents briefly expressed concerns about safety without providing much specific detail. Yet one parent stated, "I would be afraid that it would give her false confidence and she would fall and hurt herself while running or climbing." Another indicated, "Because we deal with a cognitive delay, I might have concerns about his ability to judge what is/isn't safe." Interestingly, a third parent said, "I'm not sure if my daughter would wear the robotic exoskeleton because of its appearance."

Responses to "What is your biggest concern about what might happen to your child while wearing a robotic exoskeleton?" largely pertained to general concerns about their child falling or getting hurt. However, one parent commented, "Not only would I worry about her hurting herself by slipping and falling, I'd actually worry about the skeleton itself hurting her if she fell." Another mentioned "The Hidden Burden of Exoskeletons for the Disabled," which we assumed was a reference to an article in *The Atlantic* focusing on how exoskeletons may take attention and resources away from improving a city's infrastructure for disabled individuals [30]. In summary, the majority of the qualitative results coalesced around general worries about safety. Some parents, however, expressed concerns more specifically related to the use of robotic technologies.

## Discussion

Robots are beginning to play a role in the physical rehabilitation of children, making it essential to understand how their use could change or increase the risks faced by pediatric patients. The results from our survey suggest that overtrust, at least as it pertains to the use of exoskeletons, may be a problem and that additional research should be devoted to the topic. The current state-of-the-art exoskeletons can provide only limited assistance with slow-speed walking under controlled conditions.

When subjects were asked to indicate one or more situations (they could select multiple choices) in which their child would want to use the device, most respondents selected more than one option. Of the 185 total selections collected from the 97 respondents, 102 of those responses (55%) indicated activities, such as climbing, that an exoskeleton is not currently designed to perform or that would place the child at significant risk if they were attempted. These responses were despite the fact that 83% of respondents claimed to have a high comfort level with robotic technologies (i.e., they are very or somewhat comfortable with new advanced technology, such as a robotic device, that they had not used before). Although only 45% of the participants indicated their child is somewhat or much more cautious compared with other children, more than 62% indicated they would typically or completely trust their child to handle risky situations with the technology.

In short, most of the surveyed parents would trust their child to use an exoskeleton even though they are aware that their child may attempt risky activities. Parents seem to think the technology will protect their child from harm even in circumstances where it is not fully capable of doing so. They appear to accept a level of risk that is not warranted by either the child's abilities or the machine's capabilities. In other words, the results suggest that overtrust may be occurring in the sense that parents might accept risk because they believe that the combination of the child and exoskeleton can perform a function that the device cannot, or the parents accept too much risk because the expectation is that the exoskeleton will mitigate the risk.

While our study has limitations, including its relatively small sample size, its findings lend some credence to the notion that parents may exhibit characteristics of overtrust in scenarios involving their children interacting with robotic exoskeletons. While familiar with robotic technology in general, the parents may not have the experience to estimate the risks associated with using this particular robotic device. This lack of experience is reflected in the trust they place in their child to handle risky situations with the technology and in the technology to notify the child of a risky situation. Here, the results were fairly divided, with approximately one-third indicating that the exoskeleton should provide an audio warning, one-third indicating a visual warning, and one-third stating that the device should vibrate, slow down, or stop working. Of course, the effectiveness of a type of warning is contingent on the user's physical and mental abilities.

These results shed some light on trust-related challenges associated with introducing a new robotic health-care technology to the public. These challenges highlight the significance of helping parents and users develop a realistic model of how the technology will perform and its limitations. The parents in our survey had an opportunity to indicate how they would like the technology to respond to risky situations. For instance, approximately 14% of the parents would have liked the device to stop working when encountering a risky situation; approximately 28% indicated that they think their child would try to use the device to climb. Having the technology stop in response to an attempt to climb could cause serious harm to the child. Determining how to warn children of risky situations in a manner that does not endanger them is clearly a crucial area of future work.

### *Limitations*

Among the potential limitations of the study is that only those parents who happened to see the survey invitation within the open time window (of two days) had the opportunity to participate. Furthermore, the survey population included only those on Facebook or who had the survey notice forwarded to them from a Facebook user. Thus, our recruitment method may suffer from a form of sampling bias. The survey population is also more highly educated (many had advanced graduate degrees) than the average American adult. A gender imbalance is present in the respondent pool; it was more heavily weighted toward male than female caregivers. The respondents also had a fairly high comfort level with computing technology and had much prior experience interacting with robotic technology, including exoskeletons.

We deliberately started with a relatively small sample size out of the larger base of potential study participants; for example, the U.S. Centers for Disease Control and Prevention claims that approximately "one in 323 children has been identified with [cerebral palsy (CP)]," and CP is only one of the conditions that can be connected to a movement disability in children [32]. In these and perhaps other respects, the study may not be fully representative of the larger population of parents of children with movement disabilities. Moreover, the self-reporting of anticipated behaviors (when filling out a survey) might not fully map onto the actual behaviors of parents. Furthermore, given the anonymous nature of the survey, we could not fully prevent the possibility of the same person filling out the survey multiple times.

## Conclusions and Future Research Directions

Overtrust of technology, robotic or otherwise, has already shown to have serious and sometimes disastrous consequences [33]. Our hope is that this pilot study will facilitate future research on the overtrust of robots and how to prevent its occurrence. More specifically, our study sought to evaluate the potential for overtrust of robotic exoskeletons. To more fully assess the trust that parents and others place in robotic devices, research on a larger and more diverse population is needed. This could include qualitative approaches, such as interviews, to more comprehensively gauge the views of different stakeholders. Though they can be difficult to conduct, what could complement these efforts are longitudinal studies investigating whether and how the trust that users place in robotic devices changes over time. Longitudinal studies may also suggest whether certain technologies amplify overtrust more than others or if specific types of training reduce the risks associated with overtrust.

For those who plan to pursue relevant research in the human–robot interaction realm, one strategy we recommend is to embrace the tenets of participatory design [34]–[35]. Roboticists and other professionals could work with parents and other caregivers who directly interact with patient populations to better inform the design of robots. Rather than merely seeking to anticipate what one thinks children, parents, or other users may want, a prudent path is to integrate their perspectives actively and consistently into the design process.

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