Parent Activities: Development of Children's Cognitive Skills using Robots

Brittany Evans and Allison Farnand

Supervisor: Kim Adams; Readers: Al Cook and Adrianna Rios Rincon

Short Header: Parent Manual for Robotic Play

ABSTRACT:

Typically developing children learn and develop their cognitive, language , social and motor skills by interacting with their environment. This includes playing with toys and physically manipulating objects. Children with physical limitations may not be able to fully explore their world in this way, so their opportunities for learning are limited. Robots can provide children with a means to play and learn, that they might otherwise be unable to do. Parent materials have been developed to show parents a number of different ways that robots can be used to help promote their child's development through fun learning activities. A manual, play items and the robot were distributed to parents to use with their children. The parents were asked to review the manual's accessibility and ease of use. The parents' feedback was evaluated in order to examine the experience of the parents and children of using the manual at home.

INTRODUCTION

Typically developing children develop their cognitive, social, motor and language skills through play (Knox, 2008). Chase (1994) described the cognitive development elicited from play. During the first few months, children develop object manipulation through their perception of the properties of objects. Manipulating these different toys results in new, learned behaviours that are used selectively for the type of toy being explored or goal oriented behaviour.

Object manipulation in play leads to tool use. Tool use involves the child using the object to act on the environment and requires the use of several cognitive processes. The first is causal inference, which is knowing that something causes an effect on something else (Forman, 1986). Another is means-end analysis, which is comparing a goal with the current situation and establishing the most efficient way of reducing the difference between the two (Haith et al., 1994). Coordination of multiple frames of reference is required to coordinate the tool in relation to the target object. Route planning is planning a sequence of events to reach a goal (Loux, Van Ede and Louw, 2005). The use of tools is an important cognitive skill (McCarty, Clifton, and Chollard, 2001). that has been linked to the development of problem solving and spatial skills.

Children who have a physical disability may not have the means to use object manipulation through play and develop important cognitive skills (Cook, Encarnacao, Adams, and Alvarez, 2012). For example, they may not have the fine motor control necessary to be able to grab toys and manipulate them during play, thereby inhibiting them from gradually experiencing and learning a concept such as causal inference or coordination of multiple frames

of reference. Children with severe motor disabilities cannot manipulate tools, and therefore they miss the opportunities for exploration that children with typical motor abilities would have (Cook et al., 2012). Children with physical limitations are less able to explore their environment and have fewer chances to cause an effect on the toy they are exploring (Jennings, Connors and Stegman, 1988). These children are less motivated to explore their environment and may become more dependent on the adults around them (Jennings et al., 1988). If children are anticipating difficulties performing in the tasks within their environment, they are less likely to persist on that task.

Robots are one of the tools that may offer children with physical limitations the ability to manipulate their own environment. Cook, Hoseit, Liu, Lee, and Zenteno-Sanchez (1988) presented a study in which a robot was used as a tool to bring crackers closer to the child users. The children clearly understood that the robot was being used as a tool, assessed through visual regard (i.e. looking at the arm, then the switch, then the arm with the expectation it would move).

There are different cognitive skills that can be developed by using the robot as a tool of manipulation. Cook et al. (2012) discussed six skills in their review of using robots to promote cognitive development. Cause and effect is where the action of the child (e.g. the pushing of the switch) results in a response (movement) from the robot. Negation is the understanding that the stopping of an action, or letting go of a switch, results in a response from the robot (e.g. a termination in its movement). Binary relations refers to when movement of the robot results in two opposite outcomes such as left/right, up/down or forward/back. Symbolic play is make believe play with props that can be real or imaginary. Problem solving is a sequence of

cognitive/perceptual skills required to achieve a certain goal, and could potentially be demonstrated using the robot. This includes monitoring problems in performance that need to be solved to achieve the goal. The skill of problem solving also requires the use of spatial concepts to control the robot in multiple dimensions.

Parents can be taught how to support their child's cognitive development through the use of robots in the home. To support the parents, some type of training module is required so that they know how to adequately support their child's cognitive development. According to Gee (2008), it is important to support learning not only through access to books or digital tools but to support the use of structured mentorship. Providing a training plan to parents would ensure that the right skills are targeted in play. Gee (2008) describes how learning is most successful through goal based activity and interaction with others with clear goals, available models and examples. Kaiser and Hancock (2003) asserted that parent teaching is likely to be successful when the parents choose to participate, are dedicated to learning skills important for their child's development, and have sufficient time. In summary, training programs need to present clear goals, models, examples, and feedback for parents, who in turn need to be open, available, and fully educated on the benefits of such a program and how it would support the cognitive development of their child.

In a previous project, a home based resource manual was created which outlined play activities that required the use of robots to target cause and effect, negation, binary relations and sequencing skills (Sam, Sawatzky, Schafer & Zaba, 2012). The materials were developed to show parents a number of different ways that robots could be used to help promote their child's development through fun learning activities. The current study examined the experience

of the parents and children of using the manual at home.

METHODS

The study included a pilot study followed by two trials. The pilot study was conducted for the purpose of familiarizing the authors with the methods and materials in order to better present them to subsequent families.

The Pilot Study

Participants

A fellow student was invited to participate in the pilot study with her son and give feedback on the materials and tasks. The child, who we'll call Ted, was 3 years old and typically developing without any physical, cognitive or language impairments. The pilot study took place in the Assistive Technology Lab at Corbett Hall in Edmonton, Alberta.

Materials

The parent participant brought her son Ted in to the lab where the activities were set up at the center table. The materials included a LEGO Robot, a customized robot controller, switches, and the parent manual. Talking mats is a visual framework that uses picture symbols to help people with communication difficulties communicate more effectively (Murphy et al., 2005). Talking mats were included in the form of laminated sheets of paper with images of faces showing different emotions and the words "Yes" and "No". The talking mats were included as a communication aid in the event that a child was nonverbal or limited in verbal ability, allowing the child to indicate level of enjoyment for each activity.

The parent manual was 34 pages, the first three of which were introduction and background about home-based intervention and parent involvement (see Appendix A for a

sample activity). The introduction included supporting research in parent friendly language. The manual also included a cueing hierarchy for caregivers to use when the child participants required assistance. The cueing hierarchy moved from gestures (e.g. pointing to where the robot needs to go) to verbal cues, modelling, then finally hand-over-hand assistance. There were 7 activities that were organized in the manual based on the level of cognitive difficulty required for the child to successfully complete the activity. The cognitive skills targeted in the activities included cause and effect (i.e. pushing the switch), inhibition (i.e. letting go of the switch), binary relations (i.e. up/down, forward/back or left/right movements), spatial relations (i.e. controlling the robot to move in all directions to reach a toy), symbolic play (i.e. child freely uses the switches to control the robot) and problem solving (i.e. moving the robot in multiple dimensions based on the activity's demands). Each activity contained a "getting started" component that was designed to introduce the skills that the child needed to understand in order to complete the main activity. There were written and visual instructions on how to complete the full activity. After each activity, there was an extension activity that instructed the parents how to embed language concepts into the activity. There was also a real world application section on transferring the skills learned from the activity into an everyday context. Finally, there was a reflection component that directed the parents to use the talking mats and reflect with their child on how he or she felt about the activity.

The play materials that were used for all the activities included one toy car, ten foam blocks, play food, one basket, one toy cash register, toy money and two puzzles. Different combinations of play materials were used with each activity. Coloured felts were also included to place on the robot for a matching activity.

Methods

During the pilot study, the authors, Ted, and his mother met together for two hours. The authors explained the purpose of the study and introduced the activities to the mother. They gave a brief overview of the manual, gave instructions for robot use, and demonstrated a sample activity from the manual ("Breakin' It Down" with blocks). They also participated with the child until the mother felt comfortable taking over as play partner with the robot and materials. The authors observed how she followed the steps in the activity and modelled the use of the switches to control the robot.

Results

Although Ted appeared comfortable playing with the different toys, he did not understand initially how to engage with the robot. Initially, he wanted to play with the toys himself without using the robot. However, once the research assistants showed him how the robot worked (e.g. what it looked like for the robot to knock over the block pyramid) he was intrigued and wanted to control the robot. Within half an hour he was controlling the robot independently with general encouragement from his mother.

Initially, he was provided freedom to explore the robot. Ted often wanted to move the robot with his hands rather than using the switches and required some redirection to the switches from the authors and his mother. Before he associated specific functions with each switch, he pushed them randomly, just to see the robot move. He required several tries over a couple of activities to solidify the concept of a specific function being associated with each button. During the last several minutes of the session, Ted seemed to genuinely be enjoying

himself and was much more comfortable with using the controls to move the robot.

The mom was successful in explaining the activity to her son and modelling the steps of the activity for him when he had trouble. He completed the activity according to the instructions in the manual that the mother followed.

When asked how helpful the manual was, the mother commented that the pictures were the most helpful as a reference for how to set up the activity. They were what she initially looked at in the manual and what she referred back to most frequently. She offered two helpful suggestions for improving the future use of the robots and switches. She suggested that the front of the robot be distinguished from the back of the robot. She also recommended a better labelling system for the switches. They were initially set up to according to the direction of the robot (for example, the switch placed to the left of the child indicated that the robot would move to the left), however Ted did not understand this spatial arrangement. For the other participants, the authors added a feather to the back of the robot to help distinguish the robot's orientation.

The Trials

Participants

The participants for the trials included two children (aged 6 years old and 7 years old respectively) and their parents. Both were born and raised in Edmonton, Alberta, and presented with diagnoses that affected various aspects of their functioning.

The first trial participant, who we'll call Lisa, was a 6-year-old girl diagnosed at birth with Down Syndrome. She was also diagnosed with an atlantoaxial spine defect between her first and second vertebra. As a result, she had severe gross and fine motor delays as well as

extremely low tone. She mainly used signs and one word phrases to communicate her needs. She had previous experience using switches for an alternate mode of communication in group activities.

The second trial participant, who we'll call Sarah, was a seven-year-old female who presented with a diagnosis of quadriplegic spastic cerebral palsy. Her parents reported that her left side was significantly weaker than her right side. She had more fine and gross motor difficulties in her left hand and arm than in her right. In her left hand, her thumb was tucked into her palm and she had difficulty straightening out the thumb. She could not extend her left arm straight up or to the side as her muscles were too tight. She was unable to walk independently and relied on the use of a wheelchair, however she could walk a few steps using a walker. She was able to speak in full sentences and had previous experience using switches at the age of two. Sarah's mom reported that Sarah's use of switches was unsuccessful at that time due to lack of understanding of the switches' functions and motivation to use them. Both parents tried to teach Sarah how to control her power chair at age two but Sarah would not touch the switches. Sarah's parents gave up trying to teach her how to use the switches. Sarah has not used switches since she was 2 years old.

Settings

The participants lived in Edmonton and used the manual, robot, and materials in their own homes. The activities were mostly trialed in the living room either on the floor or coffee table rather than sitting at a table with chairs.

Materials

The same materials were used as in the pilot study, except for the controllers for the robot. A

commercial trainable infrared contoller and a commercial Lego remote control were used with the last participant since the customized robot controller used was being used in a different study. The robot was controlled by the trainable infrared remote control unit and the switches could be used to send the control signals to the robot. The robot for this participant did not have the same program used with the other participants. The robot was programmed to turn at a forty-five degree angle with the use of one of the switches, therefore the switch had to be pushed twice in a row to turn a full ninety degrees. However, the commercial trainable remote did not allow for any function (i.e. turning) to be used more than once at a time, therefore the robot could not turn twice in a row until a button on the commercial Lego remote controller was pressed (by the parent).

Methods

At the first meeting with the participants for the subsequent two trials, consent and assent forms were presented to the participants and signed (parents signed the consent form and child participants signed the assent form or agreed verbally). The authors explained the purpose of the study to the participants, gave a brief overview of the manual, gave instructions for robot use, and demonstrated a sample activity (i.e. “Breakin’ It Down” activity where the robot was controlled to move forward and knock down a stack of blocks) from the manual. The children were given a few minutes of exploration and were provided with feedback about using the robot. The parents were asked to review the instructions for one activity in the manual on their own and guide their child in the activity. The materials were left with the participant family for a period of four weeks in order to allow ample time and flexibility to use the robot, manual, and play materials. Upon pickup of the manual, robot, and play materials,

the authors conducted an open-ended questions interview with the caregivers about their experience, particularly related to the manual (see Appendix B for the list of questions).

Results

Lisa

As reported by her mother, Lisa enjoyed all of the activities, as indicated when she picked the happy face sign on the talking mat after the completion of every activity. There were a few activities that the parent described Lisa as particularly enjoying. Lisa really liked using the robot to knock the wooden blocks down (Activity #1). Lisa also liked the garbage can activity where the she controlled the robot to travel to the toy cans, pick up the cans and bring it back (Activity #5). The most appealing part of this activity for Lisa was being able to bring the garbage cans back towards her using the robot. In this activity, Lisa liked matching the colour on the robot to the colour on the cans. Lisa also really enjoyed the activity where she moved the robots to pick up toy animals and bring them back. Her mother modified the activity so that Lisa sang a song about each animal that she moved the robot to.

Lisa's mother appreciated having access to the manual over the four week period. This length of time was good for the family as she reported they had plenty of time to try out the manual and activities. Lisa's mother did not have any other questions during the four week period that were not addressed in the manual. All of the play materials from the kit were familiar to the child as she had played with similar toys before. Lisa's mother commented that the familiarity of the toys greatly contributed to the ease of incorporating the robot in play. She explained that the manual was very easy to use because there were pictures to accompany the instructions and the instructions themselves were very clear. Lisa's mother also liked the

extension activities included in the manual as an option for extending the play, although she felt the language skills in the extension activities were beyond Lisa's current abilities.

There were some technical difficulties during the four week period related to the robot that she was not able to address with the manual. It was necessary for the authors to take the robot back to the Corbett Hall to troubleshoot the problem (the robot was not moving when ca switch was pressed).

The parents provided feedback on the limitations of Lisa controlling the robot to follow the play activities. Lisa had a hard time knocking down objects that were not as heavy as the wooden blocks. Lisa's mother recommended that for those types of activities, heavier toys be used to knock down. She explained that Lisa quickly lost interest in the "Shop Till you Drop" activity, where Lisa manipulated the robot to pick up various grocery items. Lisa also experienced difficulties manipulating the switches for each activity. Although she was physically capable of holding down the switch, she did not seem to understand that it was necessary. Lisa's mother recommended reprogramming of the robot to allow it to move on its own for a longer time period. She thought this may be easier for children who are cognitively delayed. She also thought that the second switch that moved the robot backwards wasn't as useful for carrying out the activities as the first switch that moved the robot forwards. Finally, Lisa's mother noted difficulty with activities that involved putting a piece of felt on top of the robot as the felt piece sometimes blocked the IR sensor. She advised that parents be aware of the position of the felt and ensure it is not blocking the sensor.

Sarah

The follow-up interview was conducted with the Sarah's mother. It was the father who mainly played with Sarah and he was not present at the time of the interview, so the mother communicated some of the questions to him by text message and shared his responses with us. Overall, the family reported that they had a very positive experience. Sarah's mother found the manual helpful in guiding the completion of the activities with Sarah. The parents felt that the manual included everything they needed to lead the activities with their daughter. They commented that having the pictures to accompany the instructions was very helpful.

Sarah's mother commented that the activities were generally easy for the father and Sarah to do, and that they were easy to embed in their daily routines. Sarah enjoyed manipulating the robot and played with it every night. Her mother explained that Sarah would often ask when she got to play with the robots next. Her father enjoyed the activities from the manual because it gave them a real means to play. The parents would usually follow Sarah's lead during play as she was fully capable of controlling the robot, and so they also used the robot to play additional games from the ones outlined in the manual. For instance, Sarah really enjoyed free play with the robot and liked to crash it into the sofa. The cash register was her favourite toy, and she enjoyed using the credit card to make her purchases. Sarah often picked the happy face when using the talking mat to describe her feelings after the completion of the activities.

Sarah's mother recommended programming the robot to move for a longer period of time in all directions. An example that she gave was the robot would not turn right long enough and it was hard to quickly make the robot do two right turns in a row. She suggested

that the robot be programmed to move longer, so that it would completely turn around an object.

Sarah's mother reported that they did not focus on using the language activities in the manual. She suggested that time be taken during the initial participant meeting to explain the language activities to parents in order to highlight their importance.

Sarah and her parents experienced difficulty managing the technical aspects of the robot, the remote control and the switches. Initially, when the robot was first brought to their home, the battery on the robot needed to be changed. The battery was quickly replaced by one the family had on hand, they did not have to change it again. Additionally, the family had difficulty determining which end of the robot was the front. The tires fell off frequently, and the robot also needed to be re-programmed once during the 4 week period. Finally, as mentioned under materials, the customized remote control that was used with the robot was unavailable, so the family was provided with the commercial trainable and infrared Lego controller as an alternate controllers. Despite attempts, students were unable to program the commercial controller in the same manner as the controller used with previous participants. The programming of the commercial controller was problematic in that it did not allow the operator to enact a robotic function more than once. Instead, the operator was required to alternate between functions, even when only one function was desired (e.g. if the operator of the controller wanted the robot to continuously move forward, he or she had to push forward, and then choose another direction before forward could again be selected). As a solution, a the Lego remote controller was provided to the family along with the commercial controller. The operator of the robot could push the "Stop" button on the Lego controller which then allowed

the desired function on the commercial controller to be repeated.

DISCUSSION

Play is an important and universal medium through which children experience the world (Knox 2008). This experience is vital to learning and the development of many skills. Children with physical and cognitive limitations often miss out on the opportunity to learn through play in the same way other children do due to difficulty manipulating objects for themselves (Cook et al. 2012). Robots have been shown to be a useful tool in giving children with cognitive and physical limitations increased autonomy in their experience of play (Cook et al. 1988). Since much of a child's experience with play happens in the home, home programs and materials are sensible resources for the purpose of facilitating an independent experience of play in a natural environment and on a consistent basis. As parents are often the primary play partner, particularly for children with cognitive and physical limitations, it is important to provide resources that are easy to use so that they can effectively guide their children's play experience.

Based on the results from the open ended interviews conducted, using robots as a means to play was a positive experience for both families. The activities seemed engaging for the participants and the toys appeared to be age appropriate. Lisa's family found that the toys were familiar to the children. This likely made the activities in the manual easier to introduce to the child. Sarah's family found that the activities were easily embedded in everyday routines. This likely had an impact on the how often the family tried the activities in the manual.

All of the families commented that the manual's instructions for the main activities were

easy to follow. Two of the mothers participating in the study directly commented on how the pictures aided the ease of following the directions from the manual. However, some things in the manual were not clear, for instance, the extension language activities.

The four week time period seemed to be a reasonable amount of time for the families to try every activity with their child. This extended time period allowed the families to play with the robots at their leisure. Since the robots were left at their homes, the families could play with the robots at various times in the day when they had free time. This longer time period also allowed the child control the robot during play aside from the play activities in the manual.

One limitation pointed out by the parents was that there was no information in the manual about how to troubleshoot technical issues related to the robot. Both of the trial participants required technical support related to the robot at some point during the study. These issues required that the authors bring the robots from the participants' homes to the laboratory at the University to troubleshoot the errors. This disrupted the access that the families had to the robot during their four week period and likely disrupted the play routines that were starting to form in the home environment. To improve the current manual, a troubleshooting section should be included that addresses questions related to changing the battery of the robot and what to do if the switches do not seem to be controlling the robot (e.g., check that the infrared signal from the remote controller box has a direct line of sight to the robot infrared receiving window). This would likely improve the ease of incorporating the robot into play and would increase the frequency of its use.

Having parents fill out a schedule indicating which activities they completed is recommended in order to collect information in future studies (see Appendix C). The schedule

would also be a method of accountability to help keep the activities in the parents daily routine during the four week period. Additionaly, the schedule could incorporate the child's talking mat responses after each activity. The child's response could be tracked to examine overall trends of their enjoyment of the activities.

While both participants in this study were willing to conduct a final interview regarding their family's experience with the robot and manual, it was often difficult for them to remember details about which activities they tried, what they did to modify the activities, how often they used the materials, how long the play experiences usually were, etc. A questionnaire for parents at the end of the four week period is recommended (see Appendix D for a list of recommended questions). This would encourage the parents focus in on more specific details of their experiences with the robot and manual. A question could include asking them to choose one activity and analyze whether the child was successful at that activity. A questionnaire would aid in the comparison of different experiences.

One limitation of the study was the small number of participants. There were only two families that trialed the manual and robot. The two children participating in the study had markedly different profiles, and as such they were difficult to compare. One child had both cognitive and physical delays and the other child had only physical delays. As a result, it was difficult to look for trends amongst these children. The results were mainly obtained from examining each parents' experience following the manual and executing the activities.

Although the families commented on the frequency with which they used the robot as a means for play, there was no quantitative information collected about it. Quantitative information would have been helpful as it would provide the exact frequency that the families

interacted with the robot and the frequency of usage for each activity.

CONCLUSION

Overall the parents who participated in our study appreciated the manual and found it helpful when playing with their children. Particularly well-liked were the pictures accompanying the explanations of the activities and the clarity of the instructions. When asked about the language activities, parents were either unaware of them or did not trial them with their child, suggesting that 1) language activities may need to be more prominently featured in the manual itself, and 2) the language activities may need to be more directly emphasized by those delivering and explaining the materials. With the recommendations made based from this study, the authors foresee the robot and manual being a useful tool both for future researchers and for families of children with cognitive and physical delay.

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Appendix A: Sample Activity

"Breakin' it Down"

In this activity, your child will push the switch in front of him/her to make the robot go forward and knock down a pyramid of blocks.

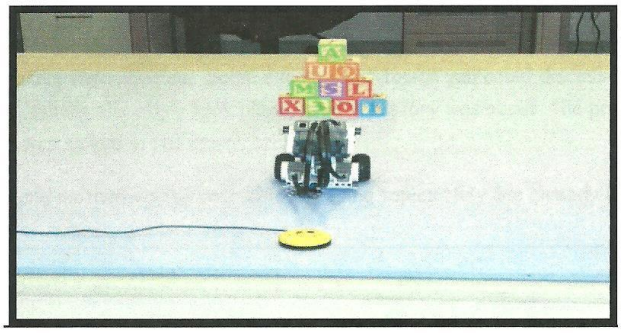
Materials Needed:

- robot and one switch (forward)
- blocks (10) stacked like a pyramid

Learning Objectives:

In this activity, your child will learn:

- the concept of cause and effect
- the concept of indirectly knocking down/moving objects using a robot
- to indicate preferences and give feedback on how s/he viewed the activity (enjoyable/not enjoyable)



Instructions:

1. Place the robot in front of your child so that it is facing away from him/her.
2. Set up a pile of blocks (stacked like a pyramid) directly in front of the robot, about 30 centimetres away.
3. Place the forward switch in front of your child. Highlight that this is the switch that makes the robot go forward when it is pushed.
4. Tell your child that s/he needs to make the robot go forward to the tower of blocks at the other end of the course to knock it down.
5. If your child is having difficulty with this activity, use the strategies suggested in the cueing hierarchy (pg. 12-13). Provide the necessary supports to your child for him/her to be successful.

Extension Activities:

1. Use the robot to play a game that focuses on rhyming skills. Say to your child, "In order to make your robot go forward, you need to listen for words that rhyme. If the two words I say rhyme, make your robot go! If the two words don't rhyme, your robot does not get to go. Listen carefully!" Example: Pot/Dot rhyme so your child would press the switch to make the robot go. Pot/Black do not rhyme so your child would not make the robot go.
2. Practice your child's weekly spelling list words using the robot. Write the target spelling words on different strips of paper (i.e. flash cards). Make sure to put in some words that are misspelled. Tell your child you are going to see how well s/he knows how to spell his/her words for the week by playing a game. If the word is spelled correctly, tell your child s/he needs to press the switch to make the robot go forward, but if the word is spelled incorrectly, your child should not press the switch to make the robot go.
3. In this fun and interactive story activity, you can find out about your child's level of understanding and memory for details. Read a story with your child. Tell your child that you are going to say some sentences that are 'facts' about the story. If the sentence you say about the story is true your child should make the robot go forward but if the sentence you say about the story is not true, your child should not make the robot go. Some examples of topics you could discuss are, the main character's name, where the story took place, what the story was about, the problem in the story, how the problem was solved in the story, etc.

Make these games fun and motivating for your child by using topics they are already learning in their lives!

Real World Application

You can adapt this activity in order to give your child a means to communicate his/her preferences in a number of different areas. For example, you can present your child with questions and have him/her indicate his/her selection by making the robot go forward or not making the robot go forward. Make the activities as meaningful and functional as you can for your child.

Reflection: Using Talking Mats

After this activity, we encourage you to ask your child how s/he feels about the activity. Questions include, "Did you think this activity was fun?", "Would you want to play this activity again?", "Would you like to play a different activity?", and/or make up your own questions as you see fit!

Appendix B - Open Interview Questions

The following questions were used in the current study when gathering feedback from parents after the four-week period with the robot and materials.

1. How often did you use the robot and materials? And how was it used?

2. Was the manual helpful?

3. Was the manual easy to use?

4. Do you have any suggestions for improving the manual?

5. Was there anything else you liked about the robot and/or materials?

6. Was there anything else you would like to see improved?

7. Is there anything else you would like to share with us about your experience?

Appendix C - Activity Form

The following form was designed as a suggested resource for parent participants to track their use of and experience with the robot and materials.

Date: _____

Time: _____

Duration of Play:

_____

Activity Name and Number:

_____

Toys Used:

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Comments (*likes, dislikes, problems, impact, adaptations, etc.*):

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Appendix D - Parent Questionnaire

The following questionnaire was designed as a suggested resource for collecting future feedback from parent participants.

Thank you for participating in this study! Once the time period for you and your child to trial the robot has come to an end, please consider the following questions in order to improve the experience for future recipients.

1. On a scale of 1-10, how much would you say your child enjoyed the robot and other materials? (If there were any activities or toys your child particularly liked or benefited from, please explain below).

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_____
_____
_____
_____

2. On a scale of 1-10, how easy did you find it to use the robot and toys? Please explain any particular difficulties.

_____
_____
_____
_____
_____

3. On a scale of 1-10, how easy did you find it to use (i.e. navigate, understand, etc.) the manual? Please explain any particular likes or dislikes.

_____
_____
_____
_____
_____

4. Did you notice any of your child's skills develop or improve with the use of the robot and materials? (If yes, please specify.)

_____
_____
_____
_____

5. Would you want the robot and materials to be available to you as a home program in the future?

6. Would you recommend this as a home program to others?

7. Are there any additions you would like to see to improve the materials and/or experience?