Using robot-mediated play activities to assess cognitive skills

Type of Project

Finished research project

Summary

Children with and without disabilities, aged 3 to 5 years old, utilized both a physical robot and a matching virtual robot to perform the same play activities (knocking over stacks of blocks). The activities were designed such that successfully performing them is an indication of understanding of the underlying cognitive skills (e.g. being able to press a switch such that a robot moves forward until it knocks over a stack of blocks reveals understanding of cause and effect). Participants' performance with both robots was similar when evaluated by the
success rates in each of the activities. Session video analysis encompassing participants'
behavioral, interaction and communication aspects revealed differences in sustained attention,
visuospatial and temporal perception, and self-regulation, favoring the virtual robot.
The study shows that virtual robots are a viable alternative to the use of physical
robots for assessing children's cognitive skills, with the potential of overcoming limitations of
physical robots such as cost, reliability and the need for on-site technical support.

Low-tech, high-tech products, services and contexts for play

A Lego Mindstorms car-like robot was built and children could control it through 3 switches: one made the robot go forward while the switch was pressed, the others made the robot turn 90 degrees left or right upon each switch press.
A virtual version of the robot was also devised, children using the same switches to control a virtual Lego robot on a computer screen.

The context of use

Children used both the physical and the virtual versions of the robot at their own schools but in a separate and quiet room.

Type of play in this play system

Cognitive

Practice

Social

Solitary

Objectives related to play according to ICF-CY

Play for the sake of play: Major life areas - d880 enagement in play

d8800 solitary play

Play-like activities: Therapeutic and educational objectives

b1 Mental functions

Number of participants

5-10

Chronological Age

3-6 years

Development Age

3-6 years

LUDI Categories of disabilities

Physical impairments:

Moderate

Explanation on the use of low-tech, high-tech devices, services or contexts

Explanation

No instruction, self-discovery of the participant/subject

Involvement

Adult: therapist/educator/researcher

Role

Providing instruction

Evaluation of objectives and outcome measures

Description of outcome measure(s)

Observation by professional/researcher providing the play experience

Video analysis

Information about availability of outcome measure: publisher, website, contact person

Success rates in the proposed tasks were used to compare the physical and the virtual robot.
Success rates in the proposed tasks, that required different cognitive skills (cause and effect, inhibition, laterality, and sequencing), were taken as a measure of children's understanding of the underlying cognitive skills.
A video analysis was conducted in order to evaluate the children's experience using both robots beyond the tasks' success rates.

Summary of achieved effects

- The study with children with and without disabilities shows that the performance of the participants while executing the same play tasks with both robots within the blocks scenario is similar
- The study results show that participants' performance varied with age, thus validating this proxy measure of cognitive development within the context of the skills associated with the proposed tasks
- Results encourage pursuing the development of virtual robots as assistive technologies for children with neuromotor impairments

References to the intervention or research project

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Publication

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Keywords

Augmented manipulation, cognitive skills assessment, virtual robots