THE ROYAL SOCIETY

Together Through Play: Enabling Participation for Children with Cerebral Palsy through Physical Therapy and Inclusive Design

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Cerebral Palsy (CP) is one of the leading causes of chronic impairment amongst children. CP describes various postural or movement disorders arising from brain injury prior to or shortly after birth. Anything from a single limb to the entire body may be affected, causing involuntary movement, muscle tightness restricting movement and difficulty co-ordinating actions. When an arm is affected, the development of motor skills such as grasping and manipulating objects – crucial to many day-to-day activities – is made more difficult. This is compounded by the fact that children who have difficulty writing or participating in class activities can be marginalised and don't get the full range of experience and education open to most. At the University of Leeds we are undertaking research with the goal of enabling children with CP to participate fully in society by helping them develop their motor skills, and by more inclusive design of the world around us, so that it presents fewer barriers to social participation. This requires a transdisciplinary approach, combining engineering, psychology and sociology (Figure 1).

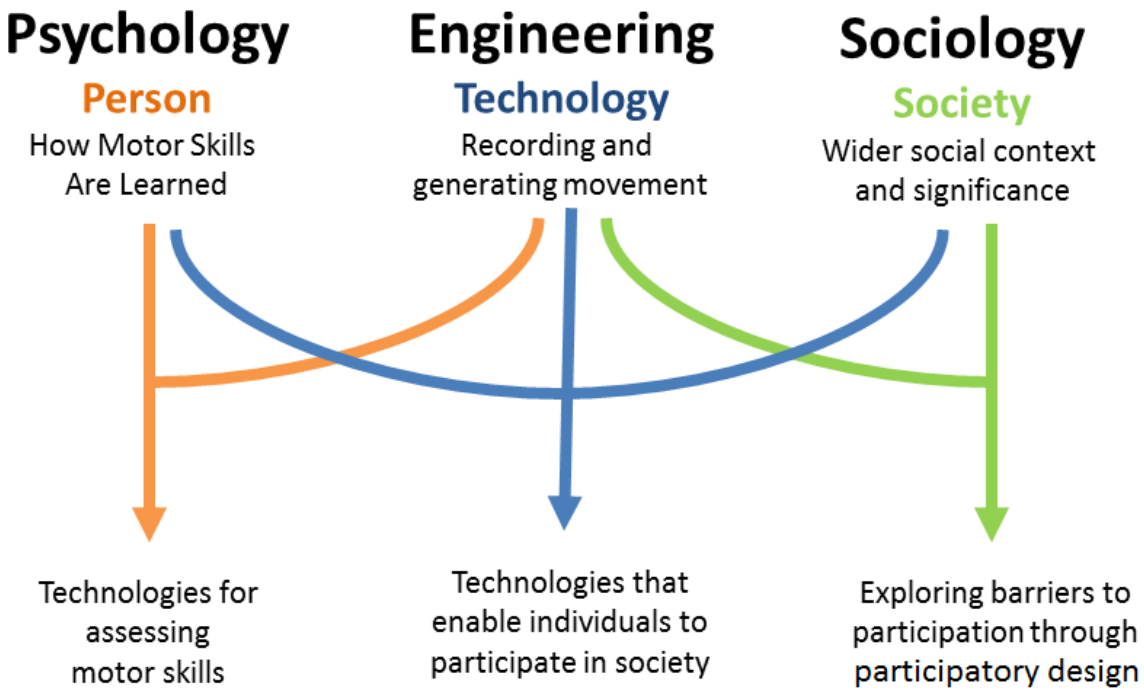

Figure 1: A transdisciplinary approach to disability

We develop software that measures motor performance through a battery of tests (such as tracing shapes accurately). This can be presented on a touch-screen or on a standard computer with an input device engineered to help children with more severe limb difficulties. A typical assessment activity is shown below, with an illustration of how in motor performance changes with age. This serves to inform designers of typical capabilities of children with CP so they can take account of them when designing; and also as a means of assessing the effectiveness of our therapeutic tools.

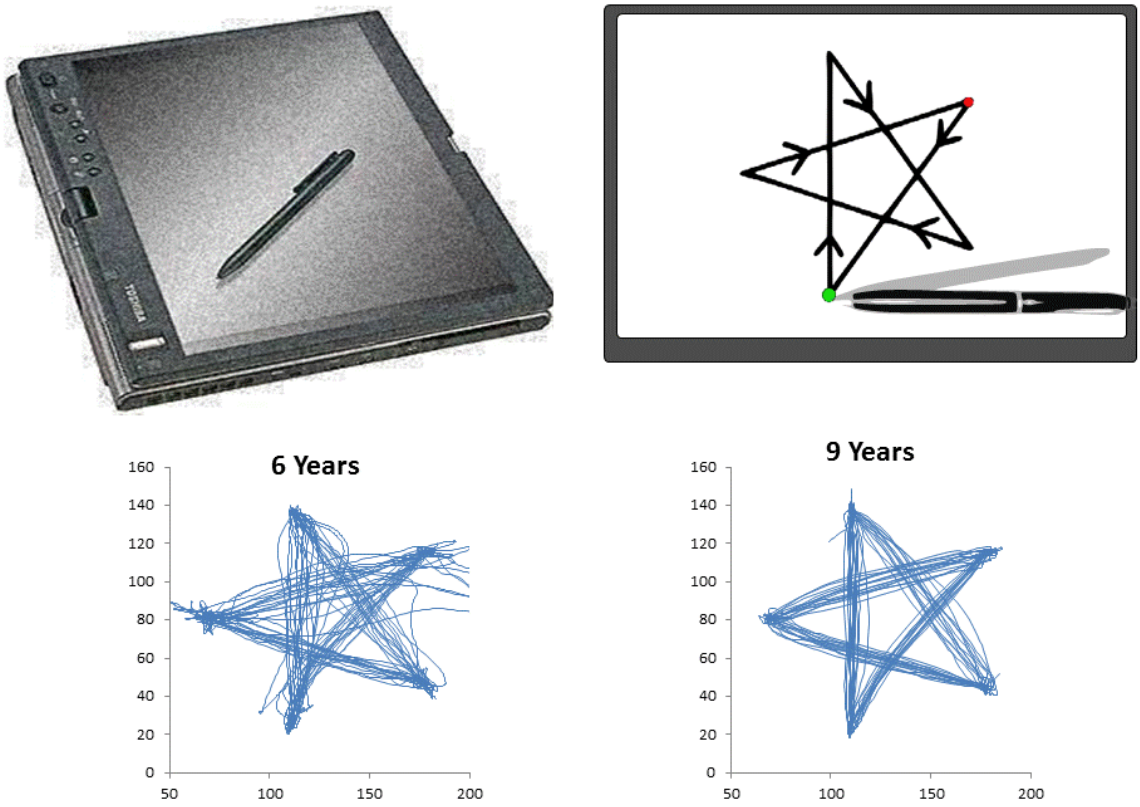

Figure 2: Example of a motor skills assessment task on a touch-screen interface

We have also developed **assisted movement devices (AMD)**, using robotics to provide assistive forces to help children with CP learn how to use their arms to greatest effect. These systems provide gentle assistance to guide the arm along an appropriate path and help the user reach that bit further than they could without assistance. We have embodied this as a games system, where the child uses a joystick to control the game, and motors in the joystick provide the assistive forces.

Figure 3: Single-player Assisted Movement Device for therapeutic play

We worked closely with a user group of children with CP and their parents in developing the system and games, to ensure that they are enjoyable and something that children actually wish to play!

Figure 4: User Group Sessions to Help Develop the AMD System and Games

At the request of our user group, we sought and received funding from the National Institute for Health Research to extend the AMD approach to a two-player system that we have deployed in schools (Figure 5).

Figure 5: The Two-Player Assisted Movement Device

The two-player approach makes the system more motivating by allowing competitive and collaborative play through games that involve rescuing monkeys from hungry crocodiles, racing down rivers and navigating mazes (Figure 5).

Figure 6: Example Games from the AMD system

The multi-player AMD approach has led us to become more interested in inclusive play -particularly where different participants have very different levels of physical ability. Play is an important part of child development, both physically and socially, and where a child is not able to play in a meaningful way with others, they may become seriously excluded. To this end we are undertaking research funded through the Leverhulme Trust to work with groups of children with and without disability to understand their aspirations for playing together – and the barriers that prevent this.

Figure 7: Word Cloud for Participating Children's Views on Play

Our research goes beyond designing "accessible" toys but involves a novel combination of engineering, psychology and sociology to identify what makes social play meaningful to the participating children. This can't be easily determined by simply asking children or watching how they play (although these are important): we actively work with children to generate ideas for games they would like to play together, then test prototypes with them (Figure 8). In this way, the expertise of sociologists in dealing with rich, qualitative data is exploited from a design perspective and, at the same time, the process of designing and prototyping helps to empower the participating children and allow them to express themselves, generating much richer data.

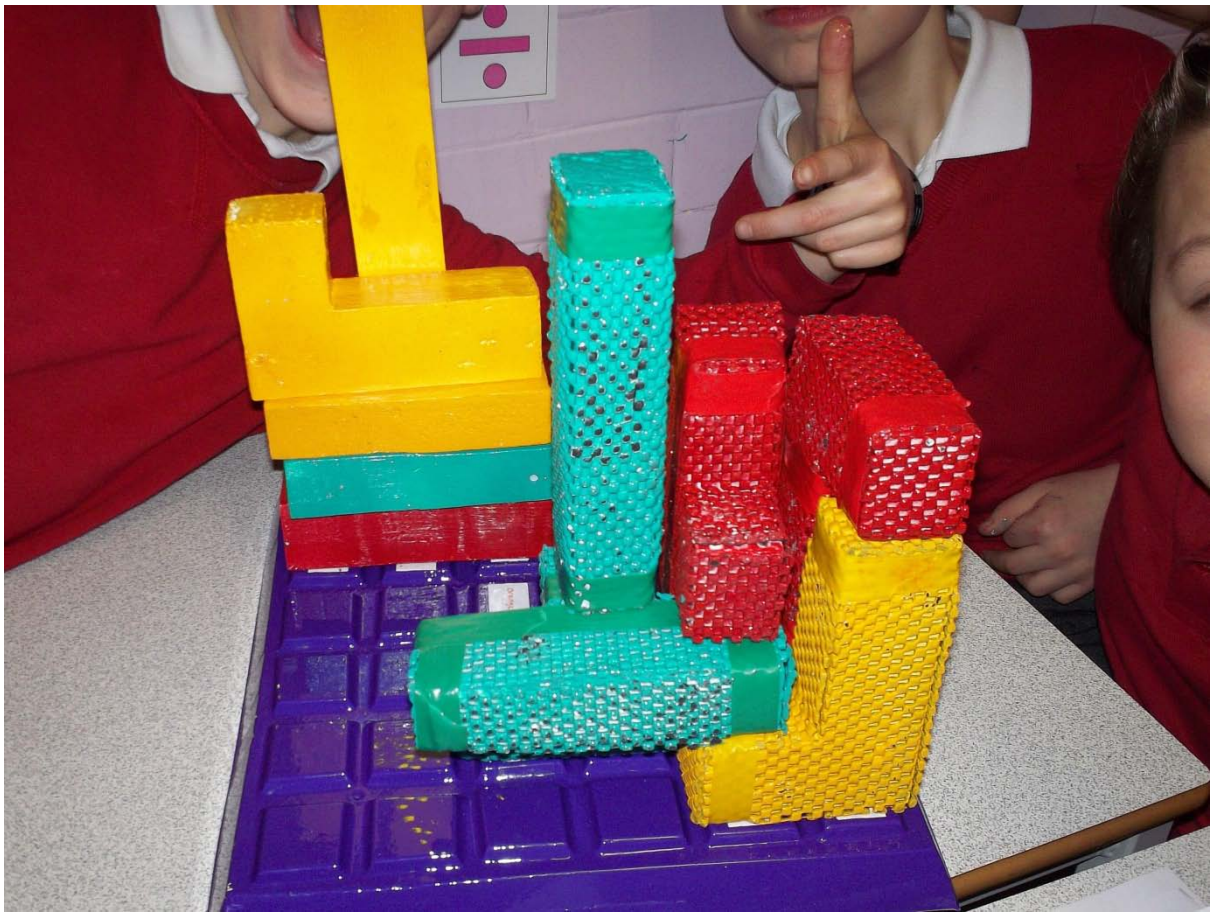

Figure 8: Testing Prototype Games.

The relationship between engineering, psychology and sociology runs deeper than complementary research methods. Psychology is the study of behaviour and uses scientific techniques to understand the human who will interface with the technology designed by engineers. Sociology explicitly considers moral dimensions and the wider social context, with much attention given to the relationships between the researcher and those they are researching – vital if we aspire to create a more inclusive society. This is particularly significant when dealing with the technical expertise of engineers and the views of children. Sociologists pay explicit attention to the fact that the topics and techniques of research are determined by powerful individual and social factors together with (often unquestioned) assumptions. Our aim in working together as engineers, psychologists and sociologists is to ensure that we challenge underlying assumptions, and place our expertise at the service of children in order to enable them, rather than simply seeing them as a technical problem to be "solved".

Further information

"Together Through Play Project" pages
Institute of Engineering Systems and Design, Faculty of Engineering, University of Leeds

An Engineering Imagination
Dr Ray Holt's blog on inclusive play projects