Rehabilitation Centre for Children

Level Up! Adaptive Gaming for Children with Upper Limb Differences

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Level Up! Adaptive Gaming for Children with Upper Limb Differences – Study Protocol

Play is an important part of childhood development [1], and it is fair to say that leisure, fun, and entertainment are all essential aspects of life. The ICF defines participation as the nature and extent of a person's involvement in life situations [2]. Participation is essential to a child's health, well being, and development, and is often the ultimate goal of pediatric rehabilitation [3]. All individuals should have the ability to participate in their choice of leisure activities [4].

Video games are a popular form of leisure and entertainment [4], especially among children and adolescents [5]. Video games encourage participation, increase motivation to complete goals, offer rewards and immediate punishments, and have adjustable difficulties to match skill level [4]. They also foster competitiveness, cooperation, immersion, sense of control, achievement of goals, and satisfaction [4]. Not only can video games be used for entertainment, but they can also be used in a more serious context, such as in education or rehabilitation [4]. Some of their uses include increasing strength and coordination, developing a sense of autonomy, increasing self confidence, and developing the ability to learn from error [4]. There are also genre specific benefits for different types of games. Some types of games promote problem solving skills and creativity. Other types of games promote healthy, optimistic motivational styles that can be seen reflected in other aspects of life, such as school or work. Other types still can foster improved mood, increased relaxation, and decreased anxiety [6]. Creating socially inclusive games and adapting game play to promote accessibility are necessary to support all children and youth in play.

For children with an amputation or upper limb difference, full participation in playing video games is not always possible. Most mainstream video games and video game controllers require bimanual dexterity and multiple degrees of freedom in both hands to be able to operate all functions. For a child missing part or all of their hand or arm, it can be difficult to access all aspects of a controller.

Current methods of video game adaptation often involve a change to the controller or game that reduces the amount of interaction the user has with the game [4]. These methods provide incomplete accessibility which can decrease the benefits of playing video games. For example, games that have been modified or designed with the intent to make the interaction simpler may result in less demands on strength, coordination, immersion, etc., meaning less benefits to be realized in these areas. The cost associated with adapting games or controllers may also be a barrier to their use. Adapted controllers also make it more difficult for users to play with others using a standard controller because controllers cannot be shared between players and the adaptive controller may have different requirements. Given that 70% of people who play video games play with others [6], the ability to participate with others is an incredibly important factor to participation.

Providing children with an upper limb amputation or difference with the ability to play any video game with a standard controller increase their ability to participate in a main-stream childhood experience. At RCC, we have developed a video game controller adapter that allows for one-handed play. It is easily attached and removed to a standard Xbox controller, which allows inclusive play between children with and without an upper limb amputation or difference. We propose that this new technology will increase both video game performance and satisfaction, allowing children with an upper limb amputation or limb difference to realize all of the benefits of playing video games with ease. We hope that this will ultimately improve quality of life for this population.

Research Purpose

The aim of this research study is to explore whether a novel video game controller adapter designed at RCC can increase performance and/or user satisfaction while playing video games, in users with unilateral upper limb differences. This case series will use mixed quantitative and qualitative methods to compare performance and user satisfaction with and without the RCC designed video game controller adapter. We will assess performance using a standard Minecraft course for all participants. Satisfaction of the adapter will be assessed with a semi-structured interview and a Visual Analog Scale (VAS) for satisfaction, and the Quebec User Evaluation of Satisfaction with assistive Technology (QUEST) outcome measure to compare play with and without the adapter for each participant.

Research Methods

Participants & Sampling Technique: Participants will be selected through convenience sampling at the Rehabilitation Centre for Children in Winnipeg, Manitoba, to a sample size of 15-20. All participants will be between the ages of 7 and 17, with unilateral upper limb differences. The upper extremity limb difference will be from any cause (congenital, trauma, secondary to other medical complications), and of any level (partial hand, wrist disarticulation, transradial, elbow disarticulation, transhumeral, shoulder disarticulation). Participants will be able to communicate in English and have the cognitive ability to follow instructions. Participants will live in Winnipeg or be willing to travel to RCC for two in person appointments (initial evaluation and final evaluation). Participants will be included regardless of history of prosthesis use.

Appropriate participants will be identified by their treating clinician (MG) and informed of the study. If they are interested in participating, they will sign a consent to contact for research form, and be contacted by another member of the research team (EH), who is not involved in their clinical care to review the consent form and ask any questions. Participants may also be recruited through self identification by sharing study information through posters at RCC, the RCC website and social media.

Data Collection: Each participant will provide informed consent before participating in any study related activities. At initial evaluation, each participant will complete a demographic questionnaire, as well as a semi-structured interview about their previous video game playing experiences, and their motivation to participate in playing video games in the future. The interviewing team member will record the interview on their phone and ensure that their phone is disconnected from the cloud. The recording will be transferred to the data storage system and then deleted from the phone. Anonymized data will be stored in a University of Manitoba Microsoft Teams environment. Following this interview, they will receive a training session from a team member (RG) on how to use the adapter and how to play Minecraft. This video game was chosen for its age appropriateness and need to use almost every button on the controller. Following the training, we will collect initial outcome measure data for both the with and without adapter conditions: time to complete the specified Minecraft “obstacle course”, accuracy of obstacle course (errors counted), VAS of satisfaction after playing, and the QUEST. Order of data collection with and without the device will be randomized to minimize a training effect.

Following the initial evaluation appointment, the participant will take home a tracking log, the video game controller adapter, and an Xbox with an Xbox One controller (if they do not already have one at home). Each participant will be asked to use the device daily and fill out the tracking log daily for 7 days. After which, each participant will return to RCC for the final evaluation appointment. At this time

the Minecraft “obstacle course” and evaluation will be repeated for gameplay with and without the adapter conditions. Finally, an exit semi-structured interview will be conducted to evaluate their experience with the adapter. Each participant will return the Xbox and controller if they were taken home. They will have the opportunity to keep the adapter if they wish.

Data Analysis: The semi structured interviews will be analyzed using an inductive coding approach as described by Thomas [7]. A transcript of the audio recorded interview will be created, formatted, and analyzed for any initial impressions and general tone. Codes will be assigned to the content of the interviews and then codes will be grouped into categories based on similarity of intent. The categories will then be refined and revised as each interview is added as a data source.
A paired t-test will be used to analyze the performance measures and QUEST responses in order to determine if there was a clinically important difference between playing with and without the adapter. A repeated measures ANOVA analysis will be used to evaluate the VAS satisfaction scores, in order to determine if there was an increase in satisfaction with increased use of the adapter.

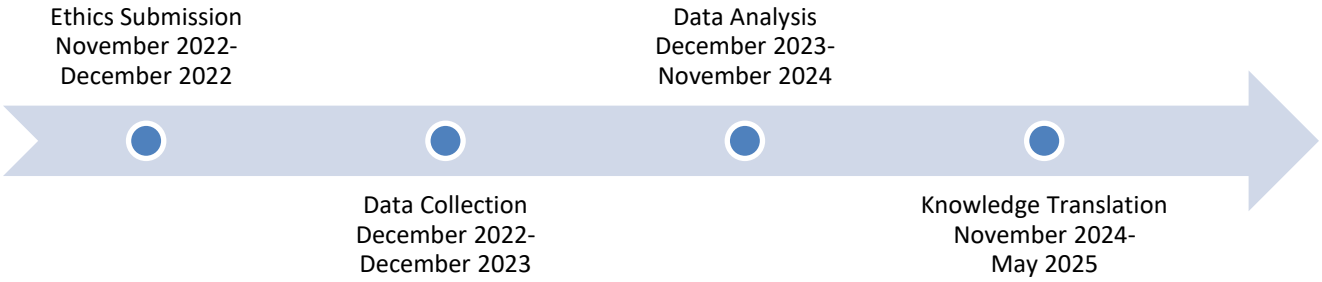
Knowledge Translation

We plan to address knowledge translation in several ways through this study. On an organizational level, we hope to share the results with the rest of the Rehabilitation Centre for Children (RCC) and Specialized Services for Children and Youth (SSCY) partners by presenting them at the monthly learning series, Breakfast at SCCY. We hope the findings of this study may translate to help additional populations seen at SSCY centre (i.e., hemiplegia/Cerebral Palsy). We also plan to share the results and adapter design with the War Amps CHAMP program, so that other children with upper limb differences across the country may benefit from the adaptation. To share our results with other health care providers, we plan to submit our results to be presented at the Association of Children’s Prosthetic Orthotic Clinics (ACPOC), Orthotics Prosthetics Canada (OPC), and RESNA Annual Conferences. Finally, we plan to write an article for a peer reviewed open-access journal to support broader knowledge translation.

Research Team

Meghan Guglich is a Certified Prosthetist with five years of experience working with children with upper limb differences. She also has a Masters in Rehabilitation Science from McMaster University. Rowen Guncheon is an engineer-in-training with experience in assistive technology design and in facilitating computer access for children with disabilities using assistive technology. Elizabeth Hammond is a physical therapist and certified hand therapist (CHT) specializing clinically in upper extremity injuries for almost 20 years. Her research has focused on the upper extremity including quantification of fine motor control post simulation of a finger amputation model and peripheral neuropathy research on neuropathic pain and the impact of exercise on neuro-regeneration and neuroprotection from Taxane chemotoxicity. Jacquie Ripat is serving as a research project advisor. She is an occupational therapist, as well as an associate professor in the Department of Occupational Therapy and the associate dean of research for the College of Rehabilitation Sciences at the University of Manitoba. Her expertise is in the use of assistive technology and qualitative and mixed methods research.

Proposed Timeline



Relevance & Future Research

We anticipate the work done in this project will inform further design changes and clinical decision making. In the future, the results of this study may help to inform treatment planning when treating individuals with a unilateral limb difference who are interested in playing video games. The results will also help to inform further design modifications, and potentially future research projects, as we continue to optimize the design of the video game controller adapter. Through knowledge translation of this study, we hope to share the design of the device further, so that other individuals outside of those treated at RCC may benefit from the use of this device. This project will also be used as a proof of concept to create adapters for other video game systems (such as Playstation, Nintendo, etc.).

References

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