Perception of Affordances in Children with Developmental Coordination Disorder

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Introduction

- Developmental Coordination Disorder (DCD) is a neurodevelopmental condition that affects approximately 5-6% of school age children, impacting their ability to learn and perform coordinated movements in everyday tasks.[3]
- The negative implications of DCD amongst children include a greater risk of academic difficulties, lower performance compared to peers, overweight/obesity, and greater risk of inactivity. [1,4,5]
- Children diagnosed with DCD are believed to have perceptual deficits.
- However, there is limited information on how children with DCD perceive affordances in immediate environment.
- Affordances are opportunities for action based on an individual's interaction within a given environment. [7]
- Virtual reality (VR) technology has recently gained popularity as a tool for investigating the perception of affordances amongst different populations.[6]
- Although head mounted displays have been used extensively to study affordances in healthy adults, it's utility in neurodevelopmental disorders research is not well-documented.

Aim

- To investigate whether children with DCD and typically developing (TD) children will differ in their perception of affordances for catching balls in virtual reality environment.

Methods

Participants

- A total of 10 participants (8 boys, 2 girls) participated on the study.
- Mean Age:13.5 years, SD: 1.80
- Participants were classified into TD and DCD using their total scores on the Movement Assessment Battery for Children, Third Edition (MABC-3).

MABC-3 Assessment

- The MABC-3 was used to diagnose children with DCD.[8]
- The MABC-3 consists of three Age bands (Age Band 1,2 and 3) broken into 10 items and three separate components (manual dexterity, aiming and catching, and balance and locomotion).
- The manual dexterity component consists of 4 items, aiming and catching consists of 3 items, and balance and locomotion consists of 3 items.
- Raw scores are converted from each of the 10 items and are transformed into a tasked scaled score based on assessment guidelines.
- The task scaled scores are then converted to a percentile.
- Based on the MABC-3, children who scored at or below the 15th percentile were classified as DCD, while those who scored at or above the 16th percentile were classified as TD.[2,3]

Experimental Procedure

- After completing the motor assessment, participants were asked to wear a head mounted display (HMD) to perform a catching task in a VR environment (Figure 1).
- 5 children with DCD and 5 age and sex-matched controls (TD) performed a ball catching task using a HMD. Their actions and performance were recorded using the HMD and a markerless motion capture system.
- Inside the virtual environment, participants were positioned in front of the soccer field goal net, facing a virtual ball-pitching machine.
- The study systematically manipulated the trajectory of the virtual balls using three conditions (overhead, eye-level, and underhead).
- Participants decided how to catch the ball at varying heights by selecting either unimanual or bimanual hand strategy.
- The hand action used by each participant was recorded and analyzed.

Instrumentation and Experimental Layout

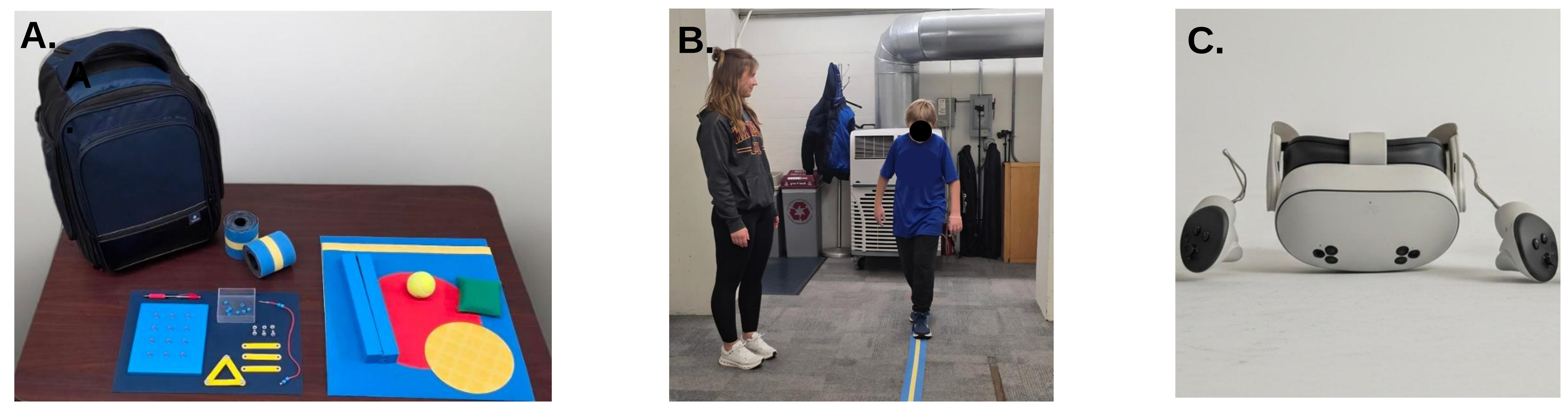
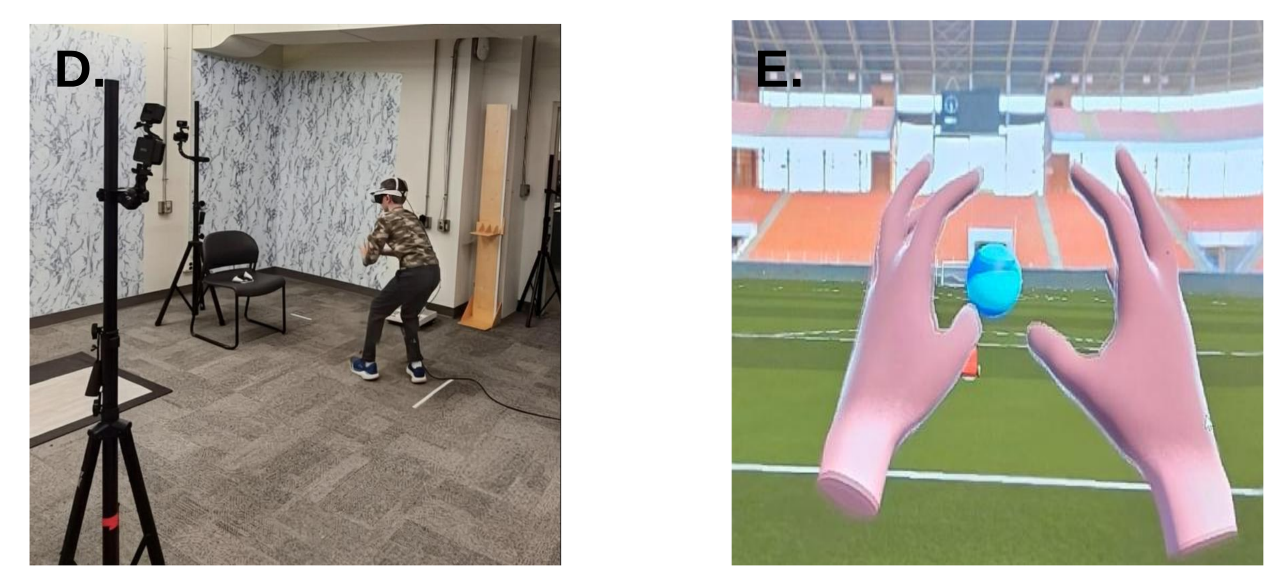


Figure 1. Diagrams showing instrument and experimental setup
- 1A: Movement Assessment Battery for Children, Third Edition (MABC-3)
- 1B: MABC-3 in action
- 1C: Meta Quest 3 Headset
- 1D: HMD Experimental Setup
- 1E: Meta Quest 3 Experimental Design



Results

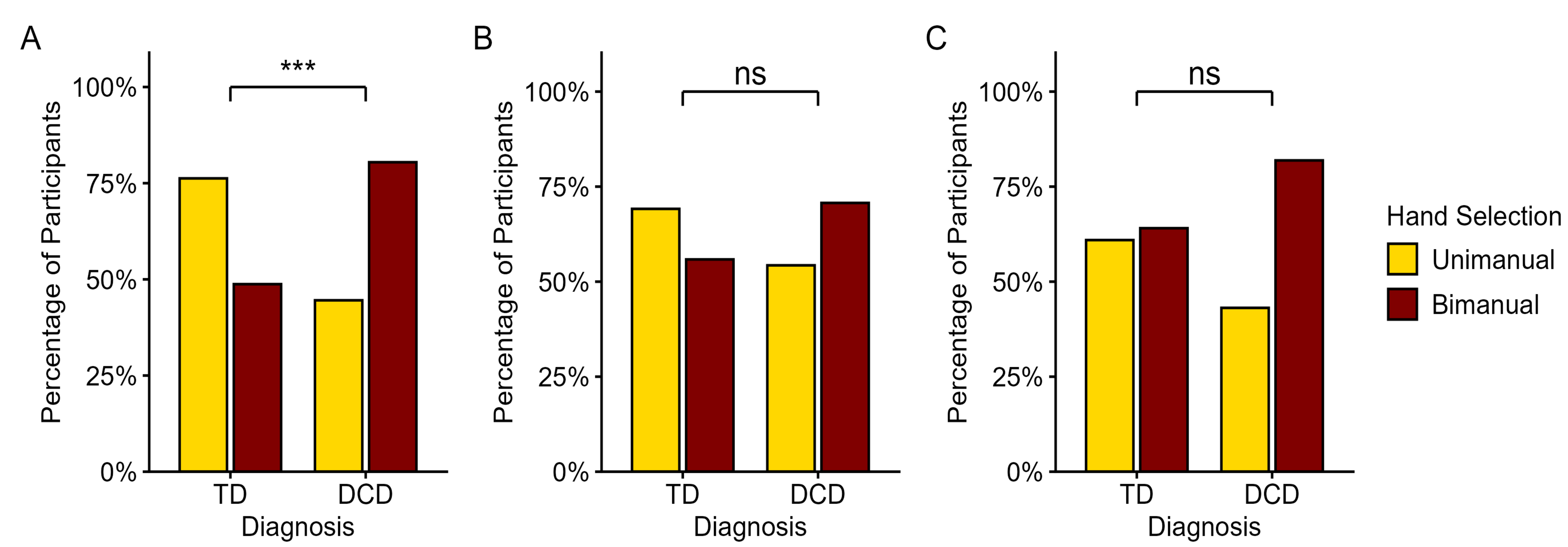


Figure 2. Hand Selection
- 2A: Ball catching hand selection at overhead level
- 2B: Ball catching hand selection at eye level
- 2C: Ball catching hand selection at underhead level

Conclusion

- Our results show that children with DCD and TD children demonstrate comparable perception of affordances for ball catching in a virtual environment when the trajectory of the ball is at eye-level or below the head.
- However, we found a significant difference in perception of affordances for ball catching when balls are released above the head, such that a greater proportion of TD children utilized unimanual strategy compared to DCD children.
- This preliminary results could be explained by perceptual deficits observed in children with DCD. Future studies should use larger samples, and analyze the biomechanical underpinnings or mechanisms.

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