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Original research

Does playing a sports active video game improve young children's ball skill competence?

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ABSTRACT

Objectives: Actual and perceived object control (commonly ball) skill proficiency is associated with higher physical activity in children and adolescents. Active video games (AVGs) encourage whole body movement to control/play the electronic gaming system and therefore provide an opportunity for screen time to become more active. The purpose of this study was to determine whether playing sports AVGs has a positive influence on young children's actual and perceived object control skills.
Design: Two group pre/post experimental design study.
Methods: Thirty-six children aged 6–10 years old from one school were randomly allocated to a control or intervention condition. The Test of Gross Motor Development-3 assessed object control skill. The Pictorial Scale of Perceived Competence for Young Children assessed perceived object control skill. The intervention consisted of 6 × 50 min lunchtime AVG sessions on the Xbox Kinect. Two to three sport games were chosen for participants to play each session. General linear models with either perceived object control or actual object control skill as the outcome variables were conducted. Each base model adjusted for intervention status and pre-score of the respective outcome variable. Additional models adjusted for potential confounding variables (sex of child and game at home).
Results: No significant differences between the control and intervention groups were observed for both outcomes.
Conclusions: This study found that playing the Xbox Kinect does not significantly influence children's perceived or actual object control skills, suggesting that the utility of the Xbox Kinect for developing perceived and actual object control skill competence is questionable.
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1. Introduction

Physical activity (PA) has been identified to have multiple health benefits for children.[1,2] As such, it is recommended children aged 5–12 years accumulate at least 60 min of moderate to high intensity PA per day.[3] However, many children around the world do not meet the PA guidelines.[4] In Australia only one in five 5–17 year olds achieve this recommendation.[5] Furthermore, with the number of screen based devices available there is concern for the time spent in sedentary behaviours.[6] The Australian electronic entertainment recommendation of 'no more than two hours of screen-based entertainment' a day was met by less than one third (29%) of children and young people between the ages of 5 and 17 years old.[5]

Fundamental movement skills (FMS) are considered the building blocks for sport-specific activities[7] and provide an important foundation for human movement and PA throughout the life span.[8] The battery of FMS typically includes locomotion skills (walking, leaping, jumping, and running), object control skills (catching, kicking and throwing) and stability skills (balance).[7] The acquisition of FMS in early childhood provides the opportunity for children to master movement skills and increases the likelihood that children will enjoy participating in physical activities.[9] Mounting evidence suggests a strong positive relationship between FMS acquisition during childhood, PA participation[10] and health benefits.[11] Yet few children meet basic FMS competency.[12–14] In Australia, between

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1997 and 2010, less than 50% of children aged 9–15 years old achieved mastery of the FMS of running, jumping, kicking, overarm throwing and catching[13] and this trend is reported globally.[12–14] The increased time children spend in front of screens coupled with physical inactivity, is potentially a contributing factor to the lack of FMS mastery in children.[12]

Active video games (AVGs) are designed to encourage whole body movement to control/play the electronic gaming system[15] and thus provide an opportunity for screen time to become more active. A recent systematic review suggested that AVGs have the potential to develop motor skills.[16] Children have reported that AVGs are easier than actually playing the game in real life,[15] potentially providing a platform for skill development. Some evidence supports the idea that AVG use is associated with higher object control proficiency.[17] Striking has been found to have the highest proportion of correctly demonstrated components compared to other object control skills (rolling and throwing) when playing AVGs.[18]

According to Harter's competence motivation theory[19] a child is more likely to continue a behaviour/activity if they believe they are proficient and have a positive self-perception of their performance. Children proficient in object control skill have higher perceptions of competence and PA as adolescents.[20] Children's perception of their movement ability in a range of movement tasks were improved after an AVG intervention,[21] and a dance mat AVG intervention increased obese adolescents' perceived competence to engage in exercise,[22] suggesting that perceived competence may be improved through AVG play.

AVGs have the potential to positively impact children's object control skills and their perceived skill competency. Sensor-based technology offers a new software element with web-cam styled devices enabling the user to interact directly without a controller, potentially increasing whole body movement.[6] The study aim was to explore whether the Xbox Kinect can be used as a novel strategy to increase children's actual and perceived competence in object control skills.

2. Methods

Informed written consent was obtained from one school principal for their school to participate in the study. Forty-three children aged 6–10 years (grades 1–4) and parents provided written informed consent for their children's participation. All study procedures were approved and in accordance with the ethical standards of the University and the Department of Education and Early Childhood Development. At the time of consent, demographic information was gathered through a parent survey, which asked for the child's sex, date of birth, weekly time (minutes) in AVG play (i.e. any AVG play, not necessarily sport games) and enrolment in organised sports/activities outside of school in for the school term preceding the study and the current term. Each listed sport/activity was coded as either a 'ball sport' (e.g. golf, tennis, football) or 'non-ball sport' (e.g. swimming, martial arts). Parents were also asked to provide demographic information such as their country of birth, language spoken most at home, highest level of education attained, and employment status. Inclusion criteria was for children with no/minimal previous AVG experience. Thus, seven children were excluded because they reported 90 min or more of regular weekly AVG game play (the upper fifth of this sample in terms of time in AVG play). Participants were randomly allocated to the intervention or control groups using a random number generator. This resulted in 19 children (53% boys) being allocated to the intervention group (mean age 7.9 years, SD 1.5) and 17 allocated to the control group (53% boys; mean age 8.0 years, SD 1.2).

The Test of Gross Motor Development (TGMD-3) assessed object control competence (two hand strike, one hand strike, ball bounce, catch, kick, underarm throw, overarm throw) according to established protocols. The TGMD[23] is normed every 15 years and the third version is due to be formally released in 2015. Each skill had a number of components that needed to be demonstrated for the skill to be performed proficiently. Every attempt was scored with each component of the skill receiving a '1' if correctly executed or a '0' if the skill was incorrectly performed. Scores of the two trials were summed to obtain a raw score for each skill. All children had their TGMD-3 skills assessed live in the school setting by two trained observers (12 h conducted by an expert trainer) blinded to intervention status. Both observers coded sample videos of children performing the TGMD-3 online as issued by the instrument developers in 2014 and scored $\geq$0.95 in terms of agreement with the coded videos. Excellent inter-rater reliability using the TGMD-2 in a previous study has been reported for these raters.[24] The two raters simultaneously evaluated 14% of the observations in this study. Using a two-way random effects model where both people effects and measures effects are random, the ICC for the seven ball skills was excellent 0.88 (0.64–0.96).

Two additional skill tests, the golf swing and putt stroke, were developed to be appropriate to the games offered through the Kinect; one of which was golf. These skills were developed via a Delphi consultation based on the TGMD skill assessment protocols. Each skill had six components to be marked as present/absent. These skills were assessed by one of the developers of this instrument blinded to intervention status. These skills have acceptable intra-rater (ICC = 0.79, 95% CI 0.59, 0.90) and test retest reliability (ICC = 0.60, 95% CI 0.23, 0.82).[25]

The Pictorial Scale of Perceived Movement Skill Competence for Young Children (PMSC) assessed children's perceived competence.[26] The instrument is designed for use with children to rate perceived movement skills using pictures which correspond to a number from one ('poor' skills) to four ('good' skills). The most recent version of the instrument (used in this study) matches the skills included in the TGMD-3 and maintains the wording structure of the version aligned with the TGMD-2.[23] The seven object control skills were assessed in this study along with two golf skills (swing and putt) maintaining the same format. Prior to using the rating scale, we assessed test retest reliability over a seven-day cycle for i) the seven matched TGMD-3 perceived items and ii) all nine items (including the two perceived golf skills). The seven TGMD-3 perceived object control skills demonstrated excellent reliability, with an ICC of 0.86 (95% CI 0.75-0.92) and so did all nine items; ICC of 0.84 (95% CI 0.73-0.91). Cronbach's alpha (for internal consistency) was also good for the seven TGMD-3 items (test 1 = 0.66, test 2 = 0.78 and all nine items (test 1 = 0.69, test 2 = 0.79). The pre/post intervention perceived competence testing was administered during school hours prior to actual skill assessment.

The six week intervention consisted of 50-min gaming sessions which were conducted once a week during school lunch time (1pm–1.50pm). Two Xbox Kinect gaming consoles were connected to two televisions in the school media room. The following Xbox Kinect games were chosen: Kinect Sports Season 1, Kinect Sports Season 2, and Sports Rivals. Specific mini-games (e.g. baseball, golf, tennis, table tennis, soccer, bowling, volleyball and football) were identified from these 3 games that involved object control skills (one/two hand strike, golf swing/putt, catch, over/under-arm throw, bounce and kick). Kinect Adventure, with limited object control games, was offered in the final week to maintain interest. Week one games consisted of tennis, table tennis and baseball, week two: baseball and golf, week three: table tennis and soccer, week four: golf and beach volleyball and week five: tennis, baseball and golf. In week six children were given the opportunity to choose their game. If a child missed a session they were asked to attend at the

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