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# Does movement proficiency impact on exergaming performance?

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ABSTRACT

There is growing interest in the use of consumer level exergames in movement skill acquisition. The purpose of this study was to investigate the relationship between movement proficiency and performance in virtual exergaming. Twenty seven children, aged 10–15 years participated in an experiment completing the Movement Assessment Battery for Children 2 (MABC-2) and a series of XBOX360 Kinect Sports exergaming tasks. Significant correlations were observed between MABC-2 aiming and catching percentile and exergame javelin and target kick, where the more proficient movers tended to perform better in the exergame. Statistically significant correlations were observed between MABC-2 balance percentile and exergaming sprint and target kick performance. In this study children who scored better in real life gross motor movement tasks performed better in most related exergaming activities. This suggests current exergaming technology has advanced to a point where body movement unencumbered by a physical or remote game device tether can extract movements resembling real life tasks, translate them into game play and reward proficient movers with higher in-game performance. It is possible that benefit gained in an exergaming environment by more proficient movers was a result of either their more proficient movement, or a greater ability to adapt to the exergame.



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## 1. Introduction

Exergames (active games, active video games, Xergames) are interactive games which, in contrast to traditional sedentary electronic games, require active body movement (Deutsch, Borbely, Filler, Huhn, & Guarrera-Bowlby, 2008; Deutsch et al., 2011; Lieberman et al., 2011; Mears & Hansen, 2009). There has been growing interest in the relationship between consumer level exergames and cardiovascular health (Mills et al., 2013) and movement skill acquisition (Fery & Ponserre, 2001) in educational settings (Fiorentino & Gibbone, 2005; Hayes & Silberman, 2007; Lieberman et al., 2011; Papastergiou, 2009; Sheehan & Katz, 2010) and in populations with movement dysfunction (Straker et al., 2011). Exergames use one, or a combination of 2 dimensional and 3 dimensional motion capture devices such as hand held haptic sensor-based remotes or foot pads, kinetic force plates, and light sensors (Deutsch et al., 2011; Levac et al., 2010; Lieberman et al., 2011; Mears & Hansen, 2009). The Microsoft Kinect (XBOX360) system utilises 3D depth cameras to capture 3D motion (Zhang, 2012). Through this technology, real environment movements are translated to virtual environment movements where the player is represented within the game as an avatar (Deutsch et al., 2011). There is debate as to whether exergaming may be a useful means for developing fundamental movement skills (FMS) (Barnett, Hinkley, Okely, Hesketh, & Salmon, 2012), which are the foundation movements that form the basis of more complex and sport specific motor skills (Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Okely & Booth, 2004). While research has shown a consistent positive association with increased FMS proficiency and higher levels of physical activity and increased sport participation (Lubans et al., 2010; Okely & Booth, 2004; Okely, Booth, & Patterson, 2001; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006), there is currently little evidence regarding the relationship between FMS proficiency and exergaming to progress this area of research (Sheehan in Katz & Clyde, 2012).

Previous work has documented a partial list of fundamental movement skills used in a select range of exergames for development of physical literacy (Sheehan & Katz, 2010), and has aligned movement skills with specific components of Wii Fit and Wii Sport in a rehabilitation context (Deutsch et al., 2011). The compendium by Deutsch and colleagues (2011) aligns the required use of balance, coordination, endurance, strength (cardiovascular and neuromuscular), and upper extremity control (unimanual and bimanual) skills in components of each Wii Fit/Sports game for ease of game selection by clinicians for beneficial exergame prescription. They did not assess movement proficiency, however, they provide a basis on which further research can expand. Barnett and colleagues (2012) investigated the relationship between fundamental movement skill proficiency and the amount of time spent in interactive and non-interactive gaming among preschool children. They found that children who spent more time playing interactive (i.e. Wii) electronic games performed better in the assessment of object control skill, however, no association was observed between interactive electronic gaming time and locomotor skills. One study that examined the link between video gaming and laparoscopic skill used three Nintendo Wii games that had movement patterns similar to those required in laparoscopic tasks (Badurdeen et al., 2010). The significant positive correlation observed between Wii and laparoscopic task performance suggests movement proficiency may extend into virtual reality with more proficient movers being rewarded in an exergaming environment. To the authors' knowledge, no research has been undertaken to examine the relationship between fundamental movement skill proficiency and exergame success.

The limited research that has been conducted on fundamental movement skills and movement patterns in commercial exergaming suggests that movement during gaming is highly varied (Levac et al. 2010; Pasch, Berthouze, van Dijk, & Nijholt, 2008; Pasch, Bianchi-Berthouze, van Dijk, & Nijholt, 2009). The required use of fundamental movement skills and movement patterns are dependent on the game activity, such as throwing, kicking or jumping and on whether full body movements or simple wrist movements to manipulate a remote are required to achieve the goals of the activity. Movement patterns both within and between exergames vary widely for individuals and between participants to achieve the same goals within exergaming contexts (Levac et al., 2010; Pasch et al., 2008, 2009). Levac and colleagues (2010, p. 1025, 1029) employed four Wii and Wii Fit exergames to determine whether children's movement quantity and quality differed between trials of the same game, between different games or between player experience status (non-experienced or experienced). A wide range