



Fine motor skill proficiency in typically developing children: On or off the maturation track?



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ABSTRACT

Fine motor skill proficiency is an essential component of numerous daily living activities such as dressing, feeding or playing. Poor fine motor skills can lead to difficulties in academic achievement, increased anxiety and poor self-esteem. Recent findings have shown that children's gross motor skill proficiency tends to fall below established developmental norms. A question remains: do fine motor skill proficiency levels also fall below developmental norms? The aim of this study was to examine the current level of fine motor skill in Irish children. Children ($N = 253$) from 2nd, 4th and 6th grades (mean age = 7.12, 9.11 and 11.02 respectively) completed the Fine Motor Composite of the Bruininks Oseretsky Test of Motor Proficiency 2nd Edition (BOT-2). Analysis revealed that only 2nd grade children met the expected level of fine motor skill proficiency. It was also found that despite children's raw scores improving with age, children's fine motor skill proficiency was not progressing at the expected rate given by normative data. This leads us to question the role and impact of modern society on fine motor skills development over the past number of decades.

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1. Introduction

Fine motor skills are the use of small muscles involved in movements that require the functioning of the extremities to manipulate objects (Gallahue & Ozmun, 2006). Fine motor skills play a key role in many activities of daily living such as self-care, feeding and dressing (Marr, Cermak, Cohn, & Henderson, 2003; Van der Linde et al., 2013). A study by McHale and Cermak (1992) found that children spend between 30% and 60% of their school day performing fine motor tasks. Those activities involving manipulation of writing implements, such as pencils, are perhaps the most important skill regarding academic achievement, with paper and pencil based activities making up as much as 85% of the time spent engaged in fine motor tasks (Marr et al., 2003). Children with strong fine motor skills have been found to demonstrate higher academic achievement, mathematical achievement and earlier development of reading (Cameron et al., 2012; Luo, Jose, Huntsinger, & Pigott, 2007). Overall, fine motor skill acquisition plays an important role in children's development as they enable participation in valued occupations of daily living, play, education and social interaction (Cools, Martelaer, Samaey, & Andries, 2009; Summers, Larkin, & Dewey, 2008a). However at present, little is known about the impact of changes occurring in the modern environment (i.e., technological and technical innovations) influence the development of fine motor skill in children.

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The dynamical systems theory offers a framework to help explain the interaction between all factors involved in these changes by postulating that the development of fine motor skill relies on the ever-changing relationship between all components of a system (e.g. the individual, the task and the environment – [Newell, 1986](#)). According to this model, motor development can be seen as the “continuous change in motor behavior throughout the life cycle, brought about by the interaction between the requirements of the movement task, the biology of the individual and the conditions of the environment” ([Gallahue & Ozmun 2006, p.25](#)). According to [Thelen and Smith \(1994\)](#), development is contingent and constantly evolving based on the environment in which it takes place. Children now grow up in an environment where they are exposed to more time engaging with digital devices such as television, tablets and video game consoles ([Biddle, Pearson, Ross, & Braithwaite, 2010](#); [Lauricella, Wartella, & Rideout, 2015](#)). These changes seem to be progressing at an alarming rate with young people consuming an average of seven hours and thirty-eight minutes of media daily, an increase of one hour and seventeen minutes since the previous measure five years previously ([Rideout, Foehr, & Roberts, 2010](#); [Roberts & Foehr, 2005](#)). As such, the environment in which children now grow up in can be quite passive with increased opportunity for engagement in sedentary behaviors that limit the varied movement experiences required for typical motor development ([Maitland, Stratton, Foster, Braham, & Rosenberg, 2013](#)).

[Thelen and Smith \(1994\)](#) argue that development is a function of the interaction between genetically determined processes and input from the environment. As motor development is a result of the interaction between the task, the individual and the environment, changes in any of these constraints have consequences on the acquisition of motor skills ([Newell, 1986](#)). There is evidence that demonstrates how these environmental changes have negatively influenced the levels of gross motor skill development and, in particular, FMS proficiency ([Hardy, Barnett, Espinel, & Okely, 2013](#)). A study by [O'Brien, Belton, and Issartel \(2015\)](#) found that only 11% of Irish 11–14 year-olds reached mastery level of 9 FMS tested. This is particularly alarming considering all skills should be mastered by ten years of age ([Gallahue & Ozmun, 2006](#)). As gross motor skill proficiency has decreased in recent times as a result of environmental factors, it is, therefore, plausible to assume that fine motor skills have also been affected. A question remains, do these environmental changes positively or negatively affect the fine motor skill development of children? As many screen-based activities such as playing video games or using tablets require fine motor skills, one could expect that these changes could potentially increase children fine motor skill proficiency levels. This has been suggested in the laparoscopic training of surgeons ([Adams, Margaron, & Kaplan, 2012](#); [Badurdeen et al., 2010](#); [Rosser et al., 2007](#)). On the other hand, certain fine motor skills could be at risk of being ‘lost in the sea of instant messaging and other technologies’ causing children’s fine motor skill acquisition to pursue a different trajectory and fall below the expected levels for children’s age and gender in the past ([Coll, 2015](#)).

When considering the motor skill level of children, it is crucial to take into account the full range of motor skill proficiency. On the lower end of the spectrum, children with motor skill impairments such as those with Developmental Coordination Disorder (DCD) are frequently reported as having difficulty when tying shoelaces, buttoning shirts, doing up zippers, brushing their teeth and using cutlery ([Cairney, Hay, & Flouris, 2005](#); [Magalhães, Cardoso, & Missiuna, 2011](#); [Missiuna, 1994](#); [Summers, Larkin, & Dewey, 2008b](#); [Wang, Tseng, Wilson, & Hu, 2009](#)). These children frequently suffer from a range of physical, social and emotional consequences ([Fitzpatrick & Watkinson, 2003](#); [Henderson & Henderson, 2003](#)). In general, children with motor skill impairments are often subject to ridicule and embarrassment, reduced self-efficacy and lower self-esteem as a result of their motor coordination problems ([Cairney et al., 2005](#); [Fitzpatrick & Watkinson, 2003](#); [Mandich, Polatajko, & Rodger, 2003](#)). Some studies have shown that this leads to avoidance of participation in activities that highlight their impairments such as play and social interaction ([Bart, Jarus, Erez, & Rosenberg, 2011](#); [Fitzpatrick & Watkinson, 2003](#); [Fong et al., 2011](#)). Unfortunately, these motor coordination problems frequently persist into adolescence and adulthood ([Cousins & Smyth, 2003](#); [Geuze & Börger, 1993](#); [Losse et al., 1991](#)). This is contrary to the belief that fine motor skill difficulties are just a stage that children “grow out of” ([Losse et al., 1991](#)). However, not all children with fine motor skill difficulties have DCD. This raises the following question: what happens to children who experience mild fine motor skill problems that cause them to fall behind the expected rate of development? With time, do these children manage to catch up and reach a mature level of fine motor skill proficiency? On the contrary, these difficulties may persist throughout life and ultimately affect their quality of life. In both cases, it is important to find out if and how the current generation of children’s fine motor skill proficiency has been affected and whether the fine motor skills necessary to succeed in modern society have been influenced by environmental factors.

In the present study, we aimed to examine the current level of fine motor skill proficiency in typically developing (TD) children and assess whether children are developing their fine motor skills at the expected rate, or whether their development has been affected by recent changes in the environment. Due to the complex level of interaction between environmental factors, it was anticipated that these changes have led to some components of fine motor skill to improve and other components to deteriorate.

2. Methods

2.1. Participants

A total of 253 children (139 males and 114 females aged 6–12 years) took part in this study. The children (71% Irish Caucasian) were randomly selected from 5 different primary schools in the Dublin area (Ireland) between January 2013 and May

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