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Research paper

Children's sports participation and self-regulation: Bi-directional longitudinal associations

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ABSTRACT

Early self-regulation is essential to positive life outcomes and sports are speculated to generate self-regulatory improvements. Preliminary research supports this assertion, showing some sports might yield short-term self-regulatory improvements and elite athletes tend to excel in cognitive functions underlying self-regulation. What remains unclear is whether sports improve self-regulation or better self-regulators engage in sport. We investigated whether sport participation in early childhood (4–5 years) predicted change in children's self-regulation two years later; and early self-regulation (4–5 years) predicted change in sports participation two years later. Data were drawn from the Longitudinal Study of Australian Children, which consisted of 4385 children with valid sports participation data at age 4–5 years. Self-regulation was indexed by parent-, teacher-, and observer-report data. Results indicated that young children who participated in individual sports demonstrated marginally but significantly higher self-regulation than those who did not participate. Participation in team sports did not predict change in self-regulation. Moreover, children with poor self-regulation were less likely to participate in sports. The findings provide partial support for hypotheses of bidirectional associations between sport participation and self-regulation in young children.

1. Introduction

There has been recent speculation that, in addition to the established physical, health, social, emotional, and psychological benefits of sports participation (for reviews see Eime, Young, Harvey, Charity, & Payne, 2013; Fraser-Thomas, Cote, & Deakin, 2005), there might also be wide ranging cognitive benefits from participating in sports. Foreshadowing this possibility, evidence of a link between physical activity and academic results has been shown in cross-sectional, longitudinal, and experimental studies (e.g., Carson et al., 2015; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Shephard, 1997). Further, there is evidence that participation in sport in high school is associated with a broad range of academic benefits (e.g., grades, attendance, aspirations; Eccles & Barber, 1999; Whitley, 1999). However, the cognitive mechanisms underlying these intellectual benefits of sports participation are less clear.

More recently, there has been suggestion that participation in sports may enhance core cognitive capacities underlying self-regulatory behaviours. These cognitive capacities, often bundled as 'executive functions' (EFs), involve the capacity and control of attention to: (i) activate and work with information in mind (working memory); (ii) resist urges, impulses, and distractions that are irrelevant to our goals or context (inhibition); and (iii) flexibly shift attention to new information and demands (cognitive flexibility) (Diamond, 2016). These cognitive control abilities combine, along with motivation, goal setting, and problem solving, to enable children's self-regulatory ability to control their thinking, behaviours, emotional reactions, and social interactions despite contrary urges, impulses, and distraction (Hofmann, Schmeichel, & Baddeley, 2014). Given the foundational importance of self-regulation, status and change of which robustly predicts children's academic success and health, wealth, and criminality in adulthood (Moffitt et al., 2011), it is thus unsurprising that success of any EF intervention is typically gauged by the extent to which its benefits transfer to self-regulatory improvement. Research on the intellectual benefits of physical activity is no exception, which has similarly sought to identify potential EF and self-regulatory benefits (e.g., academic achievement, prosocial and anti-social behaviour, persistence or frustration in response to challenge; Davis et al., 2007; Lakes & Hoyt, 2004). While self-regulation already develops rapidly in early childhood (Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016), this research has increasingly focused on younger years given suggestion that early

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intervention may produce more pronounced, stable, and lasting change (Wass, Scerif, & Johnson, 2012), and greater return on investment (Heckman, 2006).

Sports participation appears to be well suited to provide the qualities speculated to be essential for EF and self-regulatory improvements. Specifically, Diamond and Ling (2016) speculate that successful intervention requires activities that: tax and continually challenge EFs, preferably in more ecologically valid contexts to promote transfer of benefits to non-trained situations; can sustain a continually increasing EF challenge over a prolonged period, maximizing dose and duration; can minimize factors that undermine executive functioning (e.g., stress, lack of sleep, loneliness, poor health); and are genuinely enjoyable and socially connected. It is well established that participating in physical activity, including sports, can improve the psychological (e.g., stress; Long, 1985; Schnohr, Kristensen, Prescott, & Scharling, 2005), physiological (e.g., lack of sleep; Youngstedt, 2005), health (e.g., poor fitness, unhealthy weight; Cote & Hay, 2002; Wankel & Berger, 1990) and social factors that can undermine EFs (e.g., lack of social connectedness; Hansen, Larson, & Dworkin, 2003; Holt & Nelly, 2011; Wiersma & Fifer, 2008). It remains to be established, however, whether sports also engage, challenge, and improve EFs and, by extension, lead to self-regulatory change.

Conceptually, it is easy to see how participation in sports might engage and continue to challenge participants' EFs. In the case of team sports, players must use working memory to maintain rules and strategies in mind, recall where teammates and opposing players are in space and anticipate their actions, all of which are conditioned by whether you are on offence or defence. A player must also inhibit the egocentric impulse (in a Piagetian sense) to retain the ball without passing or, conversely, immediately and unconditionally offload the ball if imposing defenders approach. Inhibition would also be involved in resisting distraction from players outside the play and spectators on the sidelines. Further, players need to have the cognitive flexibility to adapt to ever-changing game demands and situations, shift attention between players and strategies, and when plans fail think creatively to find an appropriate solution. Even amongst young children who often participate in modified forms of sport, the need to remember the sport's aims and rules, inhibit impulses to simply chase the ball, and flexibly switch from offence to defence could continually challenge young children's more-limited EFs. Similarly, within individual sports, even young participants may require more intra-personal focus to control their actions (e.g., form, posture, sequence), with greater levels of support from adults (i.e., parent, coach) to help direct and control their limited attentional resources.

While there is comparatively more research establishing an effect of individual sports on EFs (e.g., Tae-Kwon Do; Lakes & Hoyt, 2004), there is currently limited empirical evidence that participation in team sports does improve EF, and none that evaluates this experimentally (Diamond, 2016). Research on the effects of team sports has largely examined the association between EFs and 'elite-ness' in sport. For instance, Vestberg, Gustafson, Maurex, Ingvar, and Petrovic (2012) found positive associations between EFs and objective sports performance (e.g., goals and assists in soccer). They also found that those participating in division soccer (i.e., high-performing) displayed better EFs than a standardized norm group. Similarly, Voss, Kramer, Basak, Prakash, and Roberts (2009) found athletic expertise was positively related to performance on a range of higher-order cognitive tasks, most notably amongst those playing interceptive sports. There is also evidence that athletes–even those who are not performing at elite levels–show higher EFs than non-athletes (Jacobsen & Matthaeus, 2014). In reporting these results, however, the researchers noted their inability to determine whether higher-EF individuals are more likely to become athletes or EFs improve as a result of participation in sports.

There is little experimental evidence investigating the directionality or reciprocal nature of the association between sports participation and self-regulation. Further, the research that does exist has looked almost exclusively at the effect of sports participation on EFs. Chang, Tsai, Chen, and Hung (2013), for example, found inhibition gains after an 8-week soccer program, although the strength of these findings was mitigated by the lack of a control group. There is also some evidence that open-skill sports participation may be an EF-protective factor among athletes with disabilities commonly characterized by EF impairment (Russo et al., 2010). While this research is far from conclusive, and examines only one possible direction of this association, these results are nevertheless suggestive. That is, if individual and team sports improve self-regulation via improvement in EFs, this would suggest a cognitive mechanism for many of the intellectual benefits of sport. Similarly, if better EFs are associated with uptake and maintenance of sports participation, this suggests a facilitator (and barrier) to participation in sport that may be a viable target for intervention.

Despite this apparent link between participation in sports and EFs, directionality of the association remains unclear. One possibility is that participation in sports promotes EF and self-regulatory development. This possibility has been widely hypothesized (e.g., Best, 2012; Diamond & Lee, 2011; Diamond & Ling, 2016), but has not been clearly established through longitudinal or experimental research. Conversely, those with better EFs may be more likely to enrol and remain in sports (Piché, Fitzpatrick, & Pagani, 2012), since EFs are essential for success in the intellectual aspects of sport (Vestberg et al., 2012; Voss et al., 2009) and we tend to better enjoy and persist in activities that we are good at (Holbrook, Chestnut, Oliva, & Greenleaf, 1984). This possibility has been speculated, yet has only preliminary support from studies with limited sample size, and demographic and socio-economic diversity (Jacobsen & Matthaeus, 2014) or studies that did not investigate bi-directionality of associations (Piché et al., 2012).

The current study thus sought to evaluate, using a large-scale, nationally representative, and longitudinal dataset, the extent to which: sport participation (any, team, or individual) in early childhood (4–5 years) predicted self-regulation change two years later (6–7 years); and children's early self-regulation (4–5 years) predicted change in sports participation two years later (6–7 years). This focus on these early years was important given early interventions, in particular, are suggested to produce more pronounced, stable, and lasting change (Wass et al., 2012), and are more likely to produce greater return on investment (Heckman, 2006). While preliminary analyses considered participation in any form of sports, given disparities in the available evidence for team and individual sports, subsequent analyses looked at these forms of sport separately. In line with prior speculation and research (Best, 2012; Diamond & Lee, 2011; Diamond & Ling, 2016; Jacobsen & Matthaeus, 2014) it was hypothesized that both individual and team sports participation would be associated with self-regulatory increases, even after controlling for baseline levels of self-regulation and known covariates. We also expected that better self-regulators would be more likely to take up and maintain participation in sports.

2. Material and methods

2.1. Participants

Data were drawn from the Longitudinal Study of Australian Children (LSAC) (Sanson, Nicholson, Ungerer, Zubrick, & Wilson, 2002). LSAC is a nationally representative and longitudinal study of Australian children that aims to examine the social, environmental, and economic impacts on children's development and well-being. Data used in the current study were largely collected from the child's primary parent (the person most responsible for care of the child, which was the child's mother in over 96% of cases), and was supplemented by observer- (trained interviewer and observer) and teacher-reported data. The majority of the study sample was attending some form of preschool provision at 4–5 years of age (96.3%; Harrison, Ungerer, Smith, Zubrick, & Wise, 2009), which roughly approximates that within the broader population (Baxter & Hand, 2013). All data were drawn from