PEER SUPPORT, EFFICACY PERCEPTIONS, AND PHYSICAL PERFORMANCE

EFFECTS OF PEER SOCIAL SUPPORT ON EFFICACY PERCEPTIONS AND PHYSICAL PERFORMANCE IN YOUTH

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LAY ABSTRACT

Social support can contribute to positive outcomes for youth in sport and physical activity settings. Social support may lead to increases in confidence, or self-efficacy. Performing challenging physical tasks after already performing a challenging cognitive task leads to decrements in self-efficacy and physical performance. The purpose of this study was to explore the effects of peer social support on relation-inferred self-efficacy (RISE; one's perception of a peer's belief in one's ability), self-efficacy, and physical performance in youth and to explore how motor coordination may influence these outcomes. When youth were provided peer social support, they reported higher RISE and their physical performance increased; however, there was no increase in self-efficacy. In addition, the findings were not influenced by motor coordination. Results suggest providing positive peer social support can lead to beneficial psychosocial and physical outcomes; however, the mechanisms through which these effects occur remain unknown.

ABSTRACT

Social interactions contribute to psychosocial and physical outcomes in youth sport and physical activity settings. Social interactions (e.g., peer social support) are theorized to inform relation-inferred self-efficacy (RISE) and, in turn, influence self-efficacy. When performing tasks that require high physical demand, prior cognitive exertion leads to decreases in self-efficacy and physical performance. The primary purpose of this study was to examine the effect of peer social support on RISE, task self-efficacy, and physical endurance performance in youth, and to explore intermediary pathways between these variables. The secondary purpose was to examine motor coordination as a moderating variable. Youth (N = 84, M_{age} = 10.43 ± 1.26) were randomly assigned to dyads and, subsequently, to either a peer social support group or a control group. All participants completed two endurance handgrip squeezes at 30% of their maximal voluntary contraction force separated by a cognitively demanding task (Stroop task). In the peer social support group, participants exchanged supportive words of encouragement prior to the second endurance handgrip squeeze, while those in the control group performed the task without prior interaction with their partner. Participants in the peer social support condition reported higher RISE (d = 0.86, p < .001) and greater improvements in physical endurance performance (d = 0.58, p < .01) compared to the control group; however, differences in task self-efficacy were non-significant (d = 0.26, p = .24). Contrary to hypotheses, there was no indirect effect of peer social support on endurance performance change through RISE and self-efficacy. In addition, there was no evidence of a moderating effect of motor coordination. Although, the mechanisms through which peer social support positively impact physical performance remain unclear, results suggest providing peer social support prior to a challenging physical task is associated with more positive RISE perceptions and improved physical performance.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition – Brief Form
d	Cohen's d
DCD	Developmental Coordination Disorder
FS	Feeling scale
M	Mean
MVC	Maximal voluntary contraction
PEP	Peers Encouraging Peers
PSS	Perceived social support
r	Pearson's correlation
RISE	Relation-inferred self-efficacy
RPE	Rating of perceived exertion
RPME	Rating of perceived mental exertion
SCT	Social Cognitive Theory
SD	Standard deviation
TTF	Time to failure
ΔTTF	Change in time to failure
VAS	Visual analogue scale

DECLARATION OF ACADEMIC ACHIEVEMENT

Kira Innes' role:

- Amended ethics application
- Designed study protocol
- Recruited participants
- Organized visits and set up lab equipment and materials
- Supervised volunteers assisting with participant recruitment and data collection
- Prepared manuscript

Role of co-authors:

- SB obtained funding for study
- SB assisted KI with ethics application
- SB assisted KI with study design
- SB assisted KI with data interpretation

INTRODUCTION

The Impact of Social Support on Health and Health-Related Behaviour

Social support refers to the assistance and protection provided by others including peers, family members, teachers, and communities (Shumaker & Bronwell, 1984). Social support has been linked to health-related behaviours and health outcomes and includes structural support (e.g., the number of family members and close friends in one's social network) as well as functional support (e.g., emotional support). Functional support can be broken down further based on whether support is perceived to be available, if needed, or if the support is actually received (Cohen & Wills, 1985). Meta-analyses of studies examining social support and health outcomes suggest perceived support is associated with lower mortality (Holt-Lunstad, Smith, & Layton, 2010), functional support is linked to lower cardiovascular mortality (Barth, Schneider, & von Kanel, 2010), and both structural and functional support are associated with lower cancer mortality (Pinquart & Duberstein, 2010). In short, research indicates social support plays an influential role in important health outcomes.

Uchino and colleagues (Uchino, Bowen, de Grey, Mikel, & Fisher, 2018) proposed a broad model to explain how social support influences health outcomes including behaviourally- and psychologically-mediated pathways (e.g., health behaviours or quality of life perceptions, respectively). One pathway within the model suggests social support influences health-related behaviours (e.g., engaging in physical activity) which, in turn, lead to improved cardiovascular function and decreased mortality. Support for this assertion comes from research showing adults who report higher levels of perceived support also report higher levels of physical activity (e.g., Andersen, Wojcik, Winnett, & Williams, 2006; Courneya, Plotnikoff, Hotz, & Birkett, 2000). In addition, social support has predicted maintenance of physical activity levels for those already meeting physical activity guidelines and predicted improvements in physical activity levels for those not engaging in recommended levels (Kouvonen et al., 2011). Overall, evidence suggests social support is an important factor associated with physical activity behaviours (Lox, Martin Ginis, & Petruzello, 2014).

Social Support in Youth Sport

In physical activity settings, the quality of one's social connections is associated with positive outcomes for youth. Generally, friendship groups affect initiation and continuation in physical activities for youth (e.g., Jago et al., 2009). More specifically, positive social connections in sport are associated with psychological outcomes including decreased perceived stress, increased motivation, and continuation in sport on the same team (Ullrich-French & Smith, 2009). Youth who have more positive perceptions of relationships with their peers also report higher enjoyment and higher motivation for sport (Ullrich-French & Smith, 2006). Children who report high social competence also report higher physical competence (Ullrich-French, McDonough, & Smith, 2012). In addition, positive peer influences are correlated with objectively measured physical activity levels across a wide age range for both males and females (Sallis, Taylor, Dowda, Freedson, & Pate, 2002). While it is unclear whether positive peer support affects physical performance itself, taken together these findings suggest youth with positive social connections in sport experience beneficial psychological outcomes and are more likely to engage in physical activity.

How Social Support May Influence Sport and Exercise Behaviour: Self-Efficacy

The beneficial effects of social support can be explained and examined through the lens of Social Cognitive Theory (SCT; Bandura, 1986). SCT suggests self-efficacy and outcome expectations are the most proximal predictors of behaviour (Bandura, 1986). Self-efficacy refers to “beliefs in one’s capabilities to organise and execute the courses of action required to produce given attainments” (Bandura, 1997, p.3). The theory of self-efficacy, within SCT, proposes self-efficacy perceptions are informed by mastery experiences, vicarious experiences, physiological and affective states, and social persuasion (Bandura, 1997). Based on theory, self-efficacy is often formed in social contexts and should increase by successfully completing tasks, by viewing peers perform tasks successfully, by experiencing positive physiological states during or following task performance, or by having positive social encouragement. Evidence from interviews with youth participating in sport found praise and encouragement were the most commonly cited sources of self-efficacy for sport (Chase, 1998).

In the exercise and physical activity literature, self-efficacy is associated with sport performance (for review see Moritz, Feltz, Fahrbach, & Mack, 2000). For example, Gould and Weiss (1981) found self-efficacy was positively associated with muscular endurance performance and George (1994) found self-efficacy to be positively associated with hitting performance in baseball. In children, those with higher self-efficacy for physical activity were more likely to choose to engage in a physical activity again after having an unsuccessful performance than children with lower self-efficacy (Chase, 2001). In a review of the physical activity literature, Sallis and colleagues (2016) found higher self-efficacy and higher social support to be consistent correlates of physical activity levels in children and adolescents. Overall, these findings support SCT and demonstrate the positive association between self-efficacy and behaviour, specifically physical activity behaviour.

From the perspective of SCT, social support is expected to influence self-efficacy and subsequently influence performance. Previous research shows verbal encouragement, which can be a form of social persuasion, provided during performance improves performance including maximal treadmill test performance (e.g., Moffatt, Chitwood, & Biggerstaff, 1994), sprint performance (Escarti & Guzman, 1999; Neto et al., 2015), and muscular endurance performance (e.g., Bickers, 1993; Hüffmeier et al., 2014). For example, in a hurdle sprint task, participants who received interpersonal feedback indicating successful performance reported higher self-efficacy for, and performed better on, a follow-up hurdle sprint task compared to those who received feedback indicating an unsuccessful performance (Escarti & Guzman, 1999). Participants with higher self-efficacy also chose to engage in a more difficult task when given difficulty level options for a subsequent hurdle sprint task (Escarti & Guzman, 1999). These findings demonstrate positive verbal feedback impacts future physical performance through increasing self-efficacy.

In children, research consistently shows verbal feedback leads to increases in self-efficacy and downstream performance outcomes in both academic and physical contexts.

For example, two studies by Schunk (1983; 1984) had children who were struggling in math class participate in math training. During training, children were either given feedback attributing correct responses to the child's ability, to their effort, to both, or to neither. Children who received feedback in support of their abilities experienced increases in self-efficacy for math and showed larger improvements in math performance compared to students who received feedback in support of effort, in support of both effort and ability, and students who received no feedback (Schunk, 1983; Schunk, 1984). These studies provide evidence for social persuasion being a source of self-efficacy and demonstrates the positive effect of self-efficacy on behavioural outcomes, yet also suggests youth's self-efficacy perceptions are sensitive to the type of feedback they received.

Among children engaging in physical tasks, verbal feedback and encouragement have also been shown to influence task performance. In one study children practiced shooting a basketball and received feedback on their performance every ten shots (Gonçalves, Cardozo, Valentini, & Chiviacowsky, 2018). Children were either provided feedback indicating their performance was better than the average child of the same age or were not given comparative feedback (Gonçalves et al., 2018). Children who received bogus positive feedback reported higher competence and performed better on a subsequent basketball shooting task than those who did not receive feedback (Gonçalves et al., 2018). In a similar study, positive comparative feedback led to increased performance on a bean bag tossing task (Avila, Chiviacowsky, Wulf, & Lewthwaite, 2012). In another study, researchers discovered that when children received positive verbal encouragement during a wall sit to failure task, they performed better than they had at baseline and improved more than those who received negative feedback (Puddefoot, Hilliard, & Burl, 1997). In concert, these findings indicate feedback and encouragement have the potential to influence physical task performance in youth; however, it remains unclear if verbal feedback and encouragement impact physical performance through processes of altering self-efficacy perceptions.

Beyond Self-Efficacy in Social Relationship Contexts

To further explain self-efficacy and how efficacy perceptions are formed in social contexts, Lent & Lopez (2002) expanded Bandura's (1997) theory of self-efficacy. They proposed a tripartite efficacy model, which incorporates multiple forms of efficacy that can arise in relational contexts. They argued that not only the existence of social persuasion but also how one perceives and internalizes the social persuasion influences self-efficacy (Lent & Lopez, 2002). Specifically, they proposed two additional forms of efficacy perceptions: other efficacy and relation-inferred self-efficacy (RISE). Other efficacy refers to one's belief in another's ability. For example, a coach has other efficacy perceptions that represent that coach's belief in a player's ability. RISE is a meta-perception representing one's estimate about another's belief in one's ability. For example, a youth athlete has a RISE perception estimating their coach's belief in the athlete's ability. RISE is therefore inherently formed within a social context and is hypothesized to impact self-efficacy. One way in which this effect could occur is when a youth athlete thinks their coach believes highly in the athlete's ability (i.e., high RISE), this causes the athlete to believe more strongly in their own ability (i.e., high self-efficacy).

RISE and Self-Efficacy in Youth

In sport and physical education settings, RISE beliefs are informed by social interactions athletes and students have with important others (e.g., coaches, teachers, peers, teammates). RISE beliefs subsequently influence self-efficacy beliefs. In a study of youth sport learning environments (i.e., sport camp), participants identified verbal and non-verbal behaviours of their coaches or instructors to provide influential information towards coach-focused RISE (Saville et al., 2014). RISE-enhancing verbal behaviours identified by youth included general encouragement prior to, during, or following a skill attempt and efficacy-building statements in which coaches expressed positive beliefs in athletes' abilities (Saville et al., 2014). RISE-enhancing non-verbal behaviours included being provided special attention during instruction, being chosen to demonstrate a skill, and providing encouraging facial expressions (e.g., smiles) and interpersonal gestures such as fist bumps and high fives (Saville et al., 2014). In a sample of youth participating in competitive sport, Saville and Bray (2016) found the frequency of RISE-enhancing coaching behaviours was positively associated with athlete's RISE perceptions. The aforementioned research serves to illustrate how specific verbal and non-verbal social interactions from coaches are influential for youth in informing their RISE perceptions and could have impacts on self-efficacy and sport related behaviours.

In sport and physical activity settings, RISE is associated with and predictive of self-efficacy. In physical education for middle-schoolers, teacher-focused RISE and students' self-efficacy were positively correlated indicating students who thought their teacher believed highly in their abilities, also believed more highly in their own physical activity abilities (Jackson, Whipp, Chua, Pengelley, & Beauchamp, 2012). In physical activity classes involving undergraduates, students' RISE with respect to their instructor predicted their own self-efficacy (Jackson, Myers, Taylor, & Beauchamp, 2012). In a series of four studies, leader-focused RISE (including coaches, teachers, and instructors) was a strong and consistent predictor of self-efficacy (Jackson, Gucciardi, Lonsdale, Whipp, & Dimmock, 2014). In youth organized sport, frequency of RISE-enhancing coaching behaviours predicted self-efficacy indirectly through RISE, suggesting higher frequency of RISE-enhancing behaviours leads to higher RISE, that subsequently leads to higher self-efficacy (Saville & Bray, 2016). When considered together, this evidence strongly suggests interactions athletes have with their coaches informs RISE, which in turn informs self-efficacy.

Although coaches and instructors may be influential sources of RISE, other athletes and teammates can also affect RISE and self-efficacy. In the first study to have examined RISE in sport, junior tennis athletes' RISE, with respect to their partner, was found to be positively associated with athletes' own self-efficacy (Jackson, Beauchamp, & Knapp, 2007). Further evidence from both competitive sport and physical education settings has found peer-focused RISE to be associated with self-efficacy (Jackson et al., 2014). Across four studies, Jackson et al. (2014) found peer-focused RISE to be a stronger predictor of self-efficacy than coach/instructor-focused RISE. Lastly, in a qualitative interview study of children participating in sports camp, peers were identified as being more influential informing self-efficacy compared to coaches and parents (Graham & Bray, 2014). Although Bandura (1997) theorized social persuasion from others with higher power or skill, such as coaches, to be the most influential, findings presented here highlight the potential for peers to also provide important sources for efficacy information.

While RISE has been consistently linked to self-efficacy, positive RISE beliefs have also been shown to have downstream effects on positive outcomes in sport. In Jackson et al.'s (2014) study, peer-focused and teacher- or coach-focused RISE were found to predict physical activity enjoyment, intentions to continue engaging in sport, intentions to continue playing on the same team, lower social physique anxiety, and more positive attitudes toward sport. Consistent with SCT, all pathways were mediated through self-efficacy (Jackson et al., 2014). In addition, when coaches have high RISE, meaning they think their athlete believes highly in their coaching ability, both athlete and coach were found to be more committed to their coach-athlete relationship (Jackson, Grove, & Beauchamp, 2010). When athletes have high coach-focused RISE, they are also more motivated to work harder (Jackson, Knapp, & Beauchamp, 2009). In physical education settings, teacher-focused RISE has been found to predict leisure time physical activity levels directly and through self-efficacy and motivation (Jackson, Whipp, & Beauchamp, 2013; Jackson, Whipp, Chua, Dimmock, & Hagger, 2013). Overall, research by Jackson and colleagues highlights a relationship between RISE and beneficial physical behaviour outcomes in youth, however it remains unclear if RISE is related to physical performance itself through self-efficacy.

Self-Efficacy for Physical Performance is Affected by Prior Cognitive Demand

As noted earlier, self-efficacy is related to physical performance and, when self-efficacy is lower, physical performance is generally worse. While studies have focused on understanding ways to increase self-efficacy and improve performance, researchers have also investigated personal and situational factors that have negative effects on self-efficacy. For instance, there is a large body of evidence showing that performing highly demanding cognitive tasks leads to decreases in subsequent physical performance (for reviews see Brown et al., *under review*; Englert, 2016; McMorris, Barwood, Hale, Dicks, & Corbett, 2018; Van Cutsem et al., 2017). Within the larger literature, several studies have shown the decrement in physical performance brought on by prior cognitive exertion is mediated by task self-efficacy (Brown & Bray, 2017b; Graham & Bray, 2015; Graham, Li, Bray, & Cairney, 2018; Graham, Martin Ginis, & Bray, 2017). In one illustrative study, children performed an isometric endurance handgrip squeeze before and after either completing a highly demanding cognitive task or a task with lower cognitive demands (Graham et al., 2018). Children who performed the more demanding task experienced decreases in endurance performance and those who completed the less demanding task experienced improvements (Graham et al., 2018). Self-efficacy was found to mediate this relationship meaning those who performed the higher demand cognitive task had lower self-efficacy for, and lower performance on, the subsequent physical task. It is important to point out that participants were given no feedback or instructions that would inform their mastery, vicarious experiences, or social persuasion. Consequently, the authors suggested self-efficacy was affected by engaging in the demanding cognitive task. Given the potential for self-efficacy to also be informed by feedback and persuasion, these findings suggest self-efficacy is a potential target for rescuing physical performance in situations, such as following high cognitive exertion, where physical performance generally suffers.

Statement of the Problem

Self-efficacy theory suggests that when forming self-efficacy perceptions, the abilities and influences of peers have strong effects on self-evaluations, particularly for children (Bandura, 1997). Research from semi-structured interviews supports this theorizing as children report relying more heavily on their impressions of their peers' beliefs rather than estimates of their coaches' beliefs to inform their self-efficacy (Graham & Bray, 2014). In addition, evidence suggests peer-focused RISE may be a stronger predictor self-efficacy than coach-focused RISE (Jackson et al., 2014). Thus, youth appear to rely more heavily on their peers than on their coaches when forming self-efficacy and so, peer-focused RISE may have larger impacts on performance through self-efficacy. However, the research carried out to this point in time has been correlational. In order to advance knowledge of the effects of peer support on RISE and self-efficacy, and the potential for RISE and self-efficacy to influence behaviour, controlled experimental research is needed.

The primary purpose of this study was to examine the effect of peer social support on RISE, task self-efficacy, and physical endurance performance in youth following a high cognitive demand task as well as to explore mediation pathways between peer social support and physical performance through RISE and self-efficacy. Drawing from Lent and Lopez's (2002) tripartite efficacy model and prior research showing strong correlations between RISE and self-efficacy, it was hypothesized that peer social support would be associated with higher RISE and self-efficacy and would lead to maintained or improved physical performance compared to when peer support was not provided. Consistent with Graham et al. (2018), it was hypothesized that physical performance would decrease following the cognitive task when support was not provided. The relationship between peer social support and physical performance was hypothesized to be mediated sequentially through RISE and self-efficacy (see Figure 2d) as positive social interactions are associated with higher RISE, RISE is predictive of self-efficacy, and self-efficacy is predictive of physical performance.

The Role of Motor Coordination on Efficacy Perceptions and Physical Performance

When children perform demanding physical tasks that involve some degree of coordination, it is important to also consider their motor coordination abilities. Children with motor coordination difficulties (e.g., developmental coordination disorder [DCD]) report lower self-perceptions (Losse et al., 1991) as well as lower self-efficacy for physical activities (Cairney, Hay, Faught, Mandigo, & Flouris, 2005; Cairney, Hay, Wade, Faught, & Flouris, 2006) and activities of daily living (Engel-Yeger & Kasis, 2010) compared to children without motor coordination difficulties. Children with motor coordination difficulties also report lower preference for physical activities and lower engagement in physical activities (e.g., Cairney et al., 2005; Engel-Yeger & Kasis, 2010). In addition, they report lower social competence and are reported by teachers to have social problems, including having difficulties with peer relations (e.g., Losse et al., 1991).

In the study by Graham et al. (2018) mentioned previously, the researchers found children who scored lower on tests of motor coordination experienced larger decreases in physical performance compared to children who were more coordinated after completing a difficult cognitive task. These findings suggest there may be differential effects on efficacy perceptions for physical tasks and physical task performance based on motor coordination abilities.

Therefore, a secondary purpose of this study was to examine motor coordination as a moderating factor in the relationship between peer social support and efficacy perceptions and physical performance. It was hypothesized that children with higher motor coordination would experience larger increases in endurance performance compared to children with lower motor coordination when provided with peer support.

To more thoroughly explore the role of motor coordination, a series of moderated mediation, or conditional indirect effects, models were tested to assess the potential moderating effect at each level of the hypothesized sequential mediation pathway (see Figure 4). Motor coordination was therefore explored as a moderating factor in the relationship between peer support and RISE, between RISE and task self-efficacy, and between task self-efficacy and endurance performance change in the in the sequential mediation of the effect of peer support on endurance performance change through RISE and task self-efficacy.

METHOD

Participants and Design

Participants were 92 children (n = 46 females; M_{age} = 10.42 ± 1.27 years; final sample N = 84, n = 43 females, M_{age} = 10.43 ± 1.26 years; see *Results* section for data-reduction reasoning) participating in a summer sports camp at a university. The camp is specifically designed to use sport as a means to influence healthy and active lifestyle choices, create positive social interactions, and foster individual development. The camp also incorporates a *Peers-Encouraging-Peers (PEP)* principle in which campers are taught the importance of positive peer interactions and how to express peer support to one another. The PEP environment was seen as advantageous as it was reasonable to assume campers had sufficient familiarity and experience with providing words of encouragement to their peers.

This study used a single blind, randomized experimental design with one independent variable with two levels: peer social support (n = 42) and control (n = 42). Participants completed the study in dyad pairs in which participants were randomly assigned to be partner A or partner B (see Figure 1). A pilot study of a coach-delivered RISE intervention showed a medium-large sized effect on youth performance of an endurance handgrip squeezing task $\eta_p^2 = 0.134$ (Bray, Graham, Saville, & Brown; unpublished). A sample size calculation (G*Power version 3.1.9.3; Faul, Erdfelder, Buchner, & Lang, 2009), based on an effect size of $\eta_p^2 = 0.134$, with power (1-β) = 0.80 and $\alpha = 0.05$, yielded a recommended sample size of N = 54 was estimated for the primary analyses assessing the effect of group on RISE, task self-efficacy, and physical performance change. Since we also intended to run sequential mediation and moderated mediation analyses with two to four predictor variables, a sample size calculation (G*Power version 3.1.9.3; Faul, Erdfelder, Buchner, & Lang, 2009; $\eta_p^2 = 0.134$, power = 0.80, and $\alpha = 0.05$) yielded a recommended sample size of $N = 83$ for regression analyses with four predictor variables. We therefore aimed to recruit a minimum of 83 participants.

The study was reviewed and approved by the McMaster Research Ethics Board prior to participant recruitment and data collection. Written informed parental consent and child assent were obtained prior to the beginning of the study. Participants received a $15 gift card for their contributions.

Primary Outcome Measures

Isometric endurance handgrip performance. The primary performance task involved participants holding a submaximal (30% of maximum voluntary contraction) endurance handgrip squeeze for as long as possible. A handgrip dynamometer (model MLT003/D; ADInstruments, Colorado Springs, CO) with digital interface (Powerlab 4/25T; ADInstruments, Colorado Springs, CO) was used to monitor and record force production. Participants used their dominant hand for all handgrip squeezes. To determine maximal voluntary contraction (MVC) force, participants completed two 4-second-duration maximal squeezes. The average force from a one-second window straddling their peak force value was used to determine maximal force production (100%MVC) and to calculate target force (30%MVC) to be used for the endurance trials. Prior to completing the first endurance trial, the experimenter demonstrated the task and allowed the participant to practice for ten seconds to ensure task understanding. While performing the endurance trials, participants had real-time visual feedback of the force they were producing as well as the target force displayed on a 17" computer monitor. For each trial, participants maintained a force at or slightly above the target force for as long as they possibly could and the trial ended when they voluntarily ceased the handgrip squeeze or when the force generated fell below the target force for more than two seconds despite instructions from the experimenter to try to increase force - at which point the experimenter signalled to them the trial was complete. The duration participants maintained the squeeze at, or above, the target force (time to failure; TTF) was recorded. Participants completed two endurance squeezes - once before the peer support manipulation (Trial 1) and once after the manipulation (Trial 2). The difference between the duration participants held the endurance handgrip squeezes (ΔTTF = TTF Trial 2 – TTF Trial 1) was calculated such that a positive score indicated improved endurance performance. The change in endurance performance (in seconds) was the primary dependent variable.

Task self-efficacy. Task self-efficacy for performance on the second endurance trial was measured using a four-item hierarchical scale previously used with children by Graham et al. (2018) that adheres to recommendations by Bandura (2005) for assessing self-efficacy. Each item began with the stem "*I am confident that I can hold the handgrip for...*". The items included "*almost as long as last time*", "*as long as last time*", "*a little bit longer than last time*", and "*a lot longer than last time*". Participants rated their confidence for each item on an 11-point scale from 0 (*not at all confident*) to 10 (*completely confident*). A task self-efficacy score was computed for each participant by averaging the confidence ratings for each item. Internal consistency for the scale was acceptable (Cronbach's α = .79).

Relation-inferred self-efficacy (RISE). Relation-inferred self-efficacy (RISE) was measured by adapting the task self-efficacy scale described above. The difference between the task self-efficacy scale and the RISE scale was the preface of the question. That is, rather than asking how confident the participant thought they were, the items each began with "*I think my peer is confident I can hold the handgrip for...*". This is consistent with previous research that has used an adaptation of a self-efficacy measure for measuring RISE (Jackson et al., 2014; Jackson, Myers, et al., 2012; Jackson, et al., 2013; Jackson, Whipp, et al., 2012; Saville & Bray, 2016). The scale consisted of the same four items as the task self-efficacy scale and were presented in the same order: "*almost as long as last time*", "*as long as last time*", "*a little bit longer than last time*", and "*a lot longer than last time*". Participants rated their perceptions of their peer's confidence on an 11-point scale from 0 (*not at all confident*) to 10 (*completely confident*). A RISE score was computed by averaging the confidence ratings for each item. Internal consistency for the scale was acceptable (Cronbach's α = .79).

Secondary Measures

Motor coordination. Motor coordination was assessed using the Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition – Brief Form (BOT-2; Bruininks & Bruininks, 2005). The BOT-2 consists of 12 tasks requiring fine motor skills (e.g., copying a star, stringing blocks together, etc.) and gross motor skills (e.g., bouncing a ball with alternating hands, walking heel to toe along a line, etc.). A score of motor coordination was calculated for each participant by summing the scores for each of the 12 tasks and converting the sum to standardized scores (established from normative data by Bruininks & Bruininks, 2005), which adjust scores based on age and sex. Motor coordination was assessed as a potential covariate and moderating variable.

Muscular strength. Given the random allocation of participants to groups, muscular strength was assessed to determine the extent to which the groups were comparable. The 100% MVC force produced from the handgrip MVC trials was used as a measure of muscular strength.

Mental fatigue. Mental fatigue was assessed using a visual analogue scale (VAS) commonly used in the mental fatigue – physical performance literature (e.g., Brown & Bray, 2017a; Smith et al., 2016). Participants were instructed to: "*Please mark X on the line the point that you feel represents your perception of your current state of mental fatigue*". The scale ranged from 0 (*None at all*) to 100 (*Maximal*) along a 100 mm line. The scale was scored by measuring how far (in millimeters) the X was from zero. Participants reported mental fatigue prior to each endurance handgrip trial.

Affect. Participants verbally reported affective valence using the Feeling Scale (Hardy & Rejeski, 1989) prior to each endurance handgrip trial. The Feeling Scale is a single item scale to assess current feeling state. It is rated on an 11-point, bi-polar scale ranging from -5 (*Very Bad*) to +5 (*Very Good*) at the scale endpoints and 0 (*Neutral*) at the centre point.

Rating of perceived physical exertion. In order to determine the extent to which participants were holding the endurance handgrip squeeze until their absolute volitional failure point with high levels of physical exertion, participants rated their perceived physical exertion (RPE) following each endurance trial using Borg's CR-10 scale (Borg, 1998), which ranges from 0 (*no exertion at all*) to 10 (*absolute maximum*).

Rating of perceived mental exertion. A modified version of Borg's CR-10 scale (Borg, 1998) was used to measure rating of perceived mental exertion (RPME) after the Stroop task as in previous studies (e.g., Bray, Graham, Martin Ginis, & Hicks, 2012). Participants reported RPME after the Stroop task to determine the extent to which the task required high levels of mental exertion. Participants rated how much mental effort was required to perform the task on an 11-point scale ranging from 0 (*nothing at all*) to 10 (*absolute maximum*).

Manipulation Checks

Perceived social support. Prior to the second handgrip trial and following the peer social support (in that group), participants in both groups were asked six questions regarding their perceived social support from their dyad partner. These included items such as "*I feel my peer would want me to perform well on this task.*". Items were rated on a 5-point Likert-type scale from 1 (*definitely not*) to 5 (*definitely*). Scale score was computed by calculating the average response from the six items. Internal consistency for the scale was good (Cronbach's $\alpha = .89$).

Experimental Manipulations

Stroop task. To induce a temporary state of mental fatigue, following the first endurance handgrip trial, participants completed a modified Stroop colour word task (Stroop, 1935). Previous research suggests motivational incentives may be most effective when in a state of mental fatigue (e.g., Brown & Bray, 2017a). The Stroop task was used because it requires participants to exert cognitive control in order to override habitual responses and leads to feelings of fatigue. In order for participants to exert cognitive control and override or inhibit a behaviour, the behaviour must first be established (Baumeister & Vohs, 2016). As such, a congruent version of the Stroop task was completed first for one minute to familiarize participants with reading aloud words printed in their *matching* font colour. Participants subsequently completed five minutes of an incongruent version of the Stroop task that required participants to say aloud the colour of font in which the words were printed while overriding the established habit of reading the words, as the words and font colours did not match. Research has found that following completion of the incongruent version of the Stroop task, physical performance is impaired in children (Graham et al., 2018). The number of words completed and of errors made during the task were recorded and differences between groups compared to determine the extent to which the groups performed similarly on the task.

Peer social support manipulation. Dyads in the peer social support condition provided verbal and non-verbal support to one another prior to the second endurance handgrip trial. A research assistant explained to partner B that they would enter the room in which partner A was completing the handgrip squeezing task and give them some words of encouragement before partner A completed the handgrip-squeezing task for the second time. Partner B was provided with a list of phrases from which they chose two that they would later say to partner A. Participants chose one of the following phrases that were more generally supportive: "*You're going to do great!*", "*Good job, you can do* *this!*", or "*I wish I could stay to cheer you on!*". They also chose one of three phrases that were previously reported by children to be influential in the formation of their RISE perceptions (Graham & Bray, 2014): "*I'm confident you'll do even better than last time!*", "*I believe you'll do even better than last time!*", or "*I know you're going to do even better than last time!*". Participants freely chose which phrases they wanted to say in order to encourage autonomy and have the words of encouragement come across as more authentic. After choosing the phrases, the research assistant wrote the phrases on a cue card for the participant and the participant practiced saying them aloud. After partner A completed the Stroop task, the research assistant and partner B entered the room and were given an explanation of what partner A was doing; after which, partner B provided the prepared words of support to partner A. Partners then exchanged a high five, and partner B left the room.

For dyads in the control group, participants engaged in the same role activities as partner A and partner B in the experimental group with the exception that they did not interact with one another to provide or receive peer support prior to the second endurance handgrip squeeze.

Procedure

The study timeline and procedure are depicted in Figure 1. Prior to participating in the study, parents of interested participants provided informed consent. When participants arrived at the lab, they were provided with verbal and written descriptions of the study and provided informed assent. Participants were then randomly assigned to be partner A or B of the dyad and randomly assigned as a dyad to an experimental group: control or peer social support. Partner A of the dyad pair remained in the lab room, while partner B went to the next room to complete the BOT-2 assessment, demographic questionnaire, and, those in the peer social support group, prepared to provide verbal support. Partner A completed two MVC trials to determine maximal grip strength and then completed the first endurance handgrip squeeze. They then completed the modified Stroop task. Participants in the peer social support group then unexpectedly received support from partner B, whereas participants in the control group continued to the following task independently. Following the social support manipulation, the participant in the role of partner A completed the RISE and task self-efficacy measures, followed by the second endurance handgrip squeeze. Partner A and B then switched roles and completed the alternate stream of the study where those in the peer support manipulation group changed roles and continued in that role until the experiment ended. Lastly, they were debriefed, thanked, and given a $15 gift card for their participation.

<table>
<tr><td rowspan="4">Assent

Scale familiarization

Assign partner A and partner B</td><td colspan="10">Partner A</td><td rowspan="4">Partner A and Partner B switch roles</td><td rowspan="4">Debrief</td></tr>
<tr><td>MVCs
Endurance demo</td><td>MF VAS
FS</td><td>Endurance trial 1
(30%MVC)</td><td>RPE</td><td>Stroop Task</td><td>RPME</td><td>Peer Social Support Manipulation</td><td>RISE
SE
PSS
MF VAS
FS</td><td>Endurance trial 2
(30%MVC)</td><td>RPE</td></tr>
<tr><td>5min</td><td>2min</td><td>~ 2min</td><td>30 sec</td><td>6min</td><td>30 sec</td><td>1min</td><td>5min</td><td>~2min</td><td>30 sec</td></tr>
<tr><td colspan="10">Partner B
Demographics
BOT-2
Prepare peer social support</td></tr>
<tr><td>3min</td><td colspan="10">25min</td><td>25min</td><td>2min</td></tr>
</table>

Figure 1. Procedural outline of measures and manipulations. (MVC = maximal voluntary contraction, MF VAS = mental fatigue visual analogue scale, FS = Feeling Scale, RPE =

rating of perceived exertion, RPME = rating of perceived mental exertion, PSS = perceived social support, RISE = relation-inferred self-efficacy, SE = self-efficacy, BOT-2 = Bruininks-Oseretsky Test of Motor Proficiency (2nd ed.))

Data Analysis

All statistical analyses were completed using SPSS version 25. Descriptive statistics were computed for all study variables. Separate one-way analysis of variance (ANOVA) models were computed for age, MVC force, BOT-2 score, affect and mental fatigue prior to each endurance handgrip trial, RPE for each endurance handgrip trial, and RPME. To ensure the Stroop task was completed and perceived comparably by both groups, words completed and errors made were compared between groups using one-way ANOVAs. A one-way ANOVA was computed for perceived social support following the peer support manipulation to check that participants correctly perceived the manipulation.

For the primary hypothesis, one-way ANOVAs were computed for change in handgrip endurance performance, RISE, and task self-efficacy scores. To determine if the peer social support manipulation differed based on the order in which participants received support (e.g., partner A vs. partner B), order effects were tested using separate 2 (Group: peer social support vs. control) x 2 (Order: partner A vs. B) factorial ANOVAs were computed for RISE, self-efficacy, and change in handgrip endurance performance.

To test for the hypothesized indirect (mediation) effects in the relationship between peer social support and physical performance change, the *PROCESS* software macro v.3 for SPSS (Hayes, 2018) was used. As recommended by Hayes and Scharkow (2013), bias-corrected bootstrap procedures utilizing 10,000 simulations were computed for all mediation analyses. It was concluded that mediation occurred if the 95% confidence interval of the indirect effect did not cross zero (Hayes, 2018). To test the simple mediation effects of RISE and task self-efficacy, model 4 was computed (Hayes, 2018; see Figure 2a-c). To test for sequential mediation through RISE and task self-efficacy, model 6 was used (Hayes, 2018; see Figure 2d).

To test for the hypothesized moderating effect of motor coordination in the relationship between peer social support and the outcome variables (RISE, task self-efficacy, and endurance performance change; see Figure 3), model 1 in the *PROCESS* software was used with motor coordination (standard score on the BOT-2) represented as a continuous variable.

Lastly, to test for moderated mediation, customized models designed based on recommendations from Hayes (2018, pp. 613-632) were computed to test for moderating effect of motor coordination in the hypothesized sequential mediation pathway, specifically between RISE and task self-efficacy and between task self-efficacy and endurance performance change (see Figure 4). In all moderation and moderated-mediation analyses, significant interaction effects were probed using the Johnson-Neyman approach (Bauer & Curran, 2005; Johnson & Neyman, 1936). This technique is used to determine the point value of the continuous moderating variable at which the effect of the dependent variable on the independent variable significantly differs (Hayes, 2018). It was concluded that moderated mediation occurred if the 95% confidence interval of the *index of moderated mediation* did not cross zero (Hayes, 2015).

RESULTS

Data Screening and Preliminary Analyses

Data were screened for normality using skewness and kurtosis based on recommendations in Kim (2013). All variables had skewness and kurtosis within the acceptable ranges (< ±2 and < ±4, respectively). In addition, the z-scores of skewness and kurtosis fell below the proposed cut off of 3.29 for medium-sized samples and we concluded the distributions were not significantly different from normal.

Data from eight participants were excluded due to: inability to complete the physical performance task appropriately (n = 1), the peer being unable or unwilling to deliver the social support manipulation (n = 2), and physical performance outcome score was >2.5 SD from the mean (n = 5). Therefore, the final sample consisted of 84 children (n = 43 females, M_{age} = 10.43 ± 1.26 years).

Order effects were tested for using 2 (group: peer social support vs. control) x 2 (order: partner A vs. B) between groups factorial ANOVAs on RISE, task self-efficacy, and performance change. There were no significant main effects of order nor interaction effects (ps > .05), meaning the order in which participants competed the two portions of the study did not impact the main outcome variables. To further justify there were no order effects, series of one-way ANOVAs were computed for RISE, task self-efficacy, and physical performance change for those in the control group and separately for those in the peer support group. In both groups, there were no differences between order in RISE, task self-efficacy, nor performance change (control, $F(1,40) < 1$, ps > .34; peer social support, $F(1,40) < 1$, *p*s > .33). As such, order was not accounted for in the main analyses.

Secondary Measures and Manipulation Checks

Descriptive statistics, ANOVA results, and effect sizes for age, secondary measures, and manipulation checks are shown by group in Table 1. Analyses revealed no significant differences between groups (*p*s > .25) for all secondary measures, therefore no covariates were included in the subsequent analyses. In the Stroop task, participants in both groups completed similar number of words and had similar number of errors suggesting comparable performance on the task between groups. Lastly, participants in the peer social support group reported significantly higher perceived social support indicating the peer social support manipulation was perceived as intended.

Table 1

Between Group Comparisons of Age, Secondary Measures, and Manipulation Checks.

	Peer Social Support *n* = 42 (21 females) *M* (*SD*)	Control *n* = 42 (22 females) *M* (*SD*)	*F*	*p*	*d*
Age	10.29 (1.25)	10.57 (1.28)	1.04	.31	0.22
Secondary Measures					
BOT-2 standard score	48.34 (8.49)	46.32 (7.22)	1.32	.25	0.26
Grip Strength (Newtons)	125.43 (30.59)	123.28 (32.45)	0.98	.76	0.07
Fatigue VAS pre-Trial 1	23.60 (19.55)	27.60 (22.42)	0.76	.39	0.19
Fatigue VAS pre-Trial 2	37.39 (27.59)	42.71 (25.45)	0.84	.36	0.20

FS pre-Trial 1	2.96 (1.71)	3.13 (1.39)	0.24	.63	0.11
FS pre-Trial 2	2.92 (1.83)	3.05 (1.40)	0.14	.71	0.08
RPE Trial 1	7.43 (1.92)	7.07 (1.83)	0.76	.39	0.19
RPE Trial 2	8.31 (1.57)	7.93 (1.73)	1.12	.29	0.23
Stroop RPME	8.06 (1.59)	8.00 (1.90)	0.02	.88	0.03
Manipulation Checks					
Stroop trials completed	184.67 (40.23)	189.21 (45.68)	0.23	.63	0.11
Stroop number of errors	15.09 (9.49)	15.31 (9.22)	0.01	.92	0.02
Perceived social support	4.13 (0.67)	3.79 (0.62)	6.03	.02	0.53

Note. *M* = mean, *SD* = standard deviation, *d* = Cohen's *d* (effect size), BOT-2 = standard score on the Bruininks-Oseretsky Test of Motor Proficiency (2nd ed.), MVC = maximal voluntary contraction in Newtons, FS = Feeling Scale, Fatigue VAS = mental fatigue on visual analogue scale, RPME = rating of perceived mental exertion, RPE = rating of perceived exertion.

Primary Analyses

Descriptive statistics summarizing endurance performance for Trial 1, Trial 2, change in endurance from Trial 1 to Trial 2, RISE, and self-efficacy are presented in Table 2. As shown in Table 2, there were no differences in endurance performance on either trial. Consistent with our hypotheses, there was a significant difference in Trial 1 to Trial 2 change ($F(1,82) = 7.14$, $p = .009$, $d = 0.58$) between groups with the peer support group showing a large positive change from Trial 1 to Trial 2 while the control group performed comparably on both trials. As predicted, the peer support group reported significantly higher RISE scores compared to the control group ($F(1,82) = 15.50$, $p <$

.001, *d* = 0.86). Task self-efficacy was slightly higher in the peer support group compared to controls; however, contrary to the hypotheses, this difference was not significant (F(1,82) = 1.41, p = .24, d = 0.26).

Table 2

Physical Performance, RISE, and Self-Efficacy by Group

	Peer Social Support *n* = 42 (21 females) *M* (*SD*)	Control *n* = 42 (22 females) *M* (*SD*)	*F*	*p*	*d*
TTF Trial 1	79.81 (39.13)	74.22 (34.78)	0.48	.49	0.15
TTF Trial 2	91.12 (43.97)	75.42 (35.96)	3.21	.08	0.39
ΔTTF	11.31 (18.18)	1.21 (16.45)	7.14	.009	0.58
RISE	7.58 (2.04)	5.71 (2.32)	15.50	< .001	0.86
Task self-efficacy	6.35 (1.98)	5.78 (2.41)	1.41	.24	0.26

Note. *M* = mean, *SD* = standard deviation, *d* = Cohen's *d* (effect size), TTF = time to failure in seconds, ΔTTF = change in TTF from Trial 1 to Trial 2, RISE = relation-inferred self-efficacy.

Mediation Analyses

To evaluate the hypothesized indirect effects of RISE and self-efficacy on the relationship between peer support and physical performance, mediation analyses were computed (Figure 2). Prior to computing mediation analyses, bivariate correlations were examined for all variables involved in the mediation models (Table 3). The mediation analysis followed a 4-step iterative procedure that first tested task self-efficacy as a mediator between group (peer social support vs. control) as the independent variable and change in endurance performance as the dependent variable. Results indicated no significant indirect effect of task self-efficacy (95% CI [-1.86, 1.00]). The second mediation model tested task self-efficacy as a mediator in the effect of RISE on change in endurance performance and showed task self-efficacy had no indirect effect (95% CI [-1.00, 1.24]). The third mediation model tested RISE as a mediator between group and change in endurance performance. Results showed no indirect effect of RISE (95% C.I. [-5.2, 1.56]). Lastly, sequential mediation of RISE and self-efficacy was tested in the relationship between group and change in endurance performance, which also showed no indirect effect (95% CI [-5.82, 1.50]).

Table 3

Bivariate correlations between efficacy perceptions, physical performance, and motor coordination.

a. Control group.

	1.	2.	3.
1. ΔTTF			
2. Task self-efficacy	0.003		
3. RISE	- 0.032	0.649***	
4. BOT-2	0.014	- 0.057	- 0.225

b. Peer social support group.

	1.	2.	3.
1. ΔTTF			
2. Task self-efficacy	- 0.040		
3. RISE	- 0.202	0.455**	
4. BOT-2	0.286†	0.004	-0.042

c. Full sample.

	1.	2.	3.
1. ΔTTF			
2. Task self-efficacy	0.021		
3. RISE	0.012	0.568***	
4. BOT-2	0.198†	- 0.010	- 0.071

Note. ΔTTF = change in TTF from Trial 1 to Trial 2, RISE = relation-inferred self-efficacy, BOT-2 = standardized score on the BOT-2. † $p < .08$, * $p < .05$, ** $p < .01$, *** $p < .001$

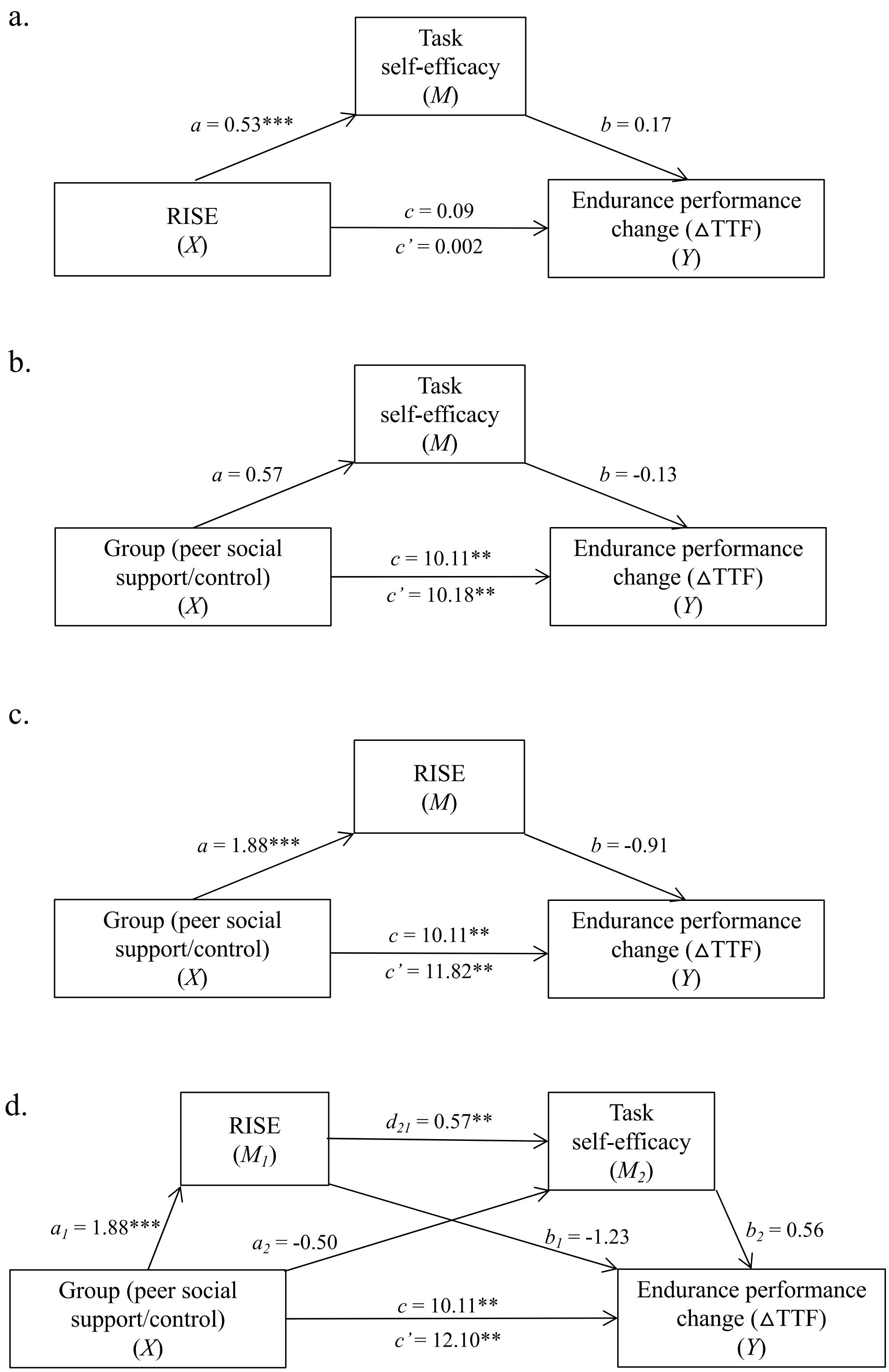
a.
Task self-efficacy (M)
a = 0.53***
b = 0.17
RISE (X)
c = 0.09
c' = 0.002
Endurance performance change (ΔTTF) (Y)
b.
Task self-efficacy (M)
a = 0.57
b = -0.13
Group (peer social support/control) (X)
c = 10.11**
c' = 10.18**
Endurance performance change (ΔTTF) (Y)
c.
RISE (M)
a = 1.88***
b = -0.91
Group (peer social support/control) (X)
c = 10.11**
c' = 11.82**
Endurance performance change (ΔTTF) (Y)
d.
RISE (M_1)
d_{21} = 0.57**
Task self-efficacy (M_2)
a_1 = 1.88***
a_2 = -0.50
b_1 = -1.23
b_2 = 0.56
Group (peer social support/control) (X)
c = 10.11**
c' = 12.10**
Endurance performance change (ΔTTF) (Y)

Figure 2. Series of mediation models exploring the relationship between group (peer social support vs. control) on endurance performance change. There was no indirect effect of task self-efficacy in the relationship between RISE and endurance performance change (a). There was also no indirect effect of group on endurance performance change through (b) task self-efficacy, (c) RISE, (d) nor sequentially through RISE and task self-efficacy. (* $p < .05$, ** $p < .01$, *** $p < .001$).

Moderation Analyses

To evaluate the potential moderating effect of motor coordination on the outcome variables (RISE, task self-efficacy, and endurance performance change), moderation analyses were computed using standardized scores from the BOT-2 as the measure of motor coordination (Figure 3). Results of the Johnson-Neyman technique analyses (Johnson & Neyman, 1936) showed there was no point along the spectrum of motor coordination (BOT-2 standardized score) at which the effect of group on endurance performance change was significantly different. This means there was no moderating effect of motor coordination on RISE ($b = 0.06$, $p = .33$, 95% CI [-0.06, 0.19]), task self-efficacy ($b = 0.02$, $p = .75$, 95% CI [-0.11, 0.15]), or endurance performance change ($b = 0.59$, $p = .25$, 95% CI [-0.42, 1.59]).

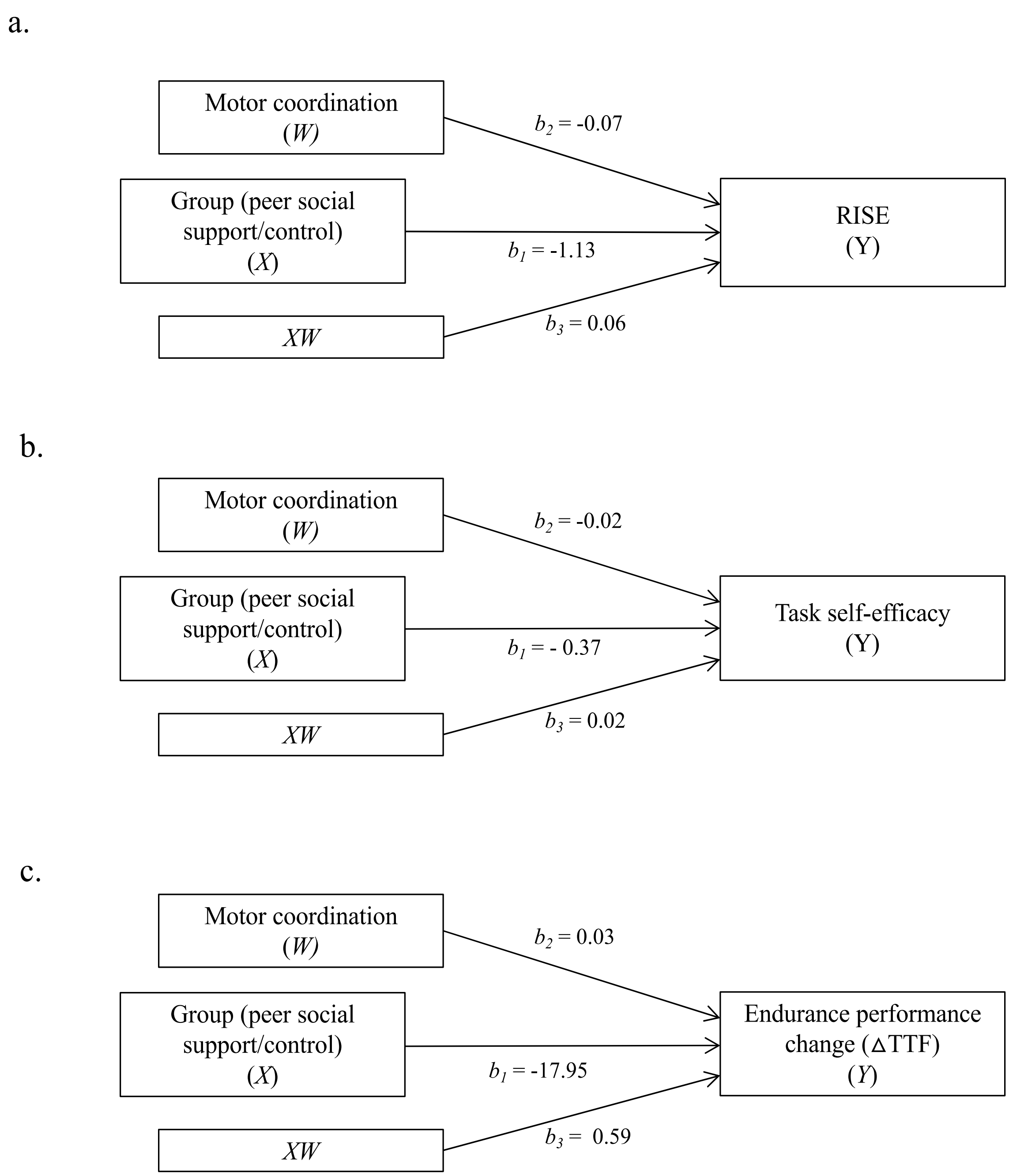

Figure 3. Simple moderation models exploring the potential moderating effect of motor coordination, measured by standard score on the BOT-2. No evidence for a moderating

effect of motor coordination was found in the relationship between group and (a) RISE, (b) task self-efficacy, nor (c) endurance performance change.

Moderated Mediation Analyses

To fully explore the potential moderating effect of motor coordination, a series of moderated mediation models (Figure 4) were tested assessing motor coordination as a moderating factor at each step of the hypothesized sequential mediation between group and endurance performance change through RISE and task self-efficacy. Although single moderated mediation models did not find motor coordination to be a moderator, it was still possible for motor coordination to be moderating effects within the complete sequential mediation model (Hayes, 2015). The first model tested motor coordination as a moderating variable between group and RISE and found no moderating effect (95% CI [-1.38, 2.17]). The second model testing motor coordination moderating between RISE and task self-efficacy also found no moderating effect (95% CI [-0.90, 1.03]). The third and final model tested if motor coordination had a moderating effect between task self-efficacy and change in endurance performance, which also showed no effect (95% CI [-4.69, 4.81]).

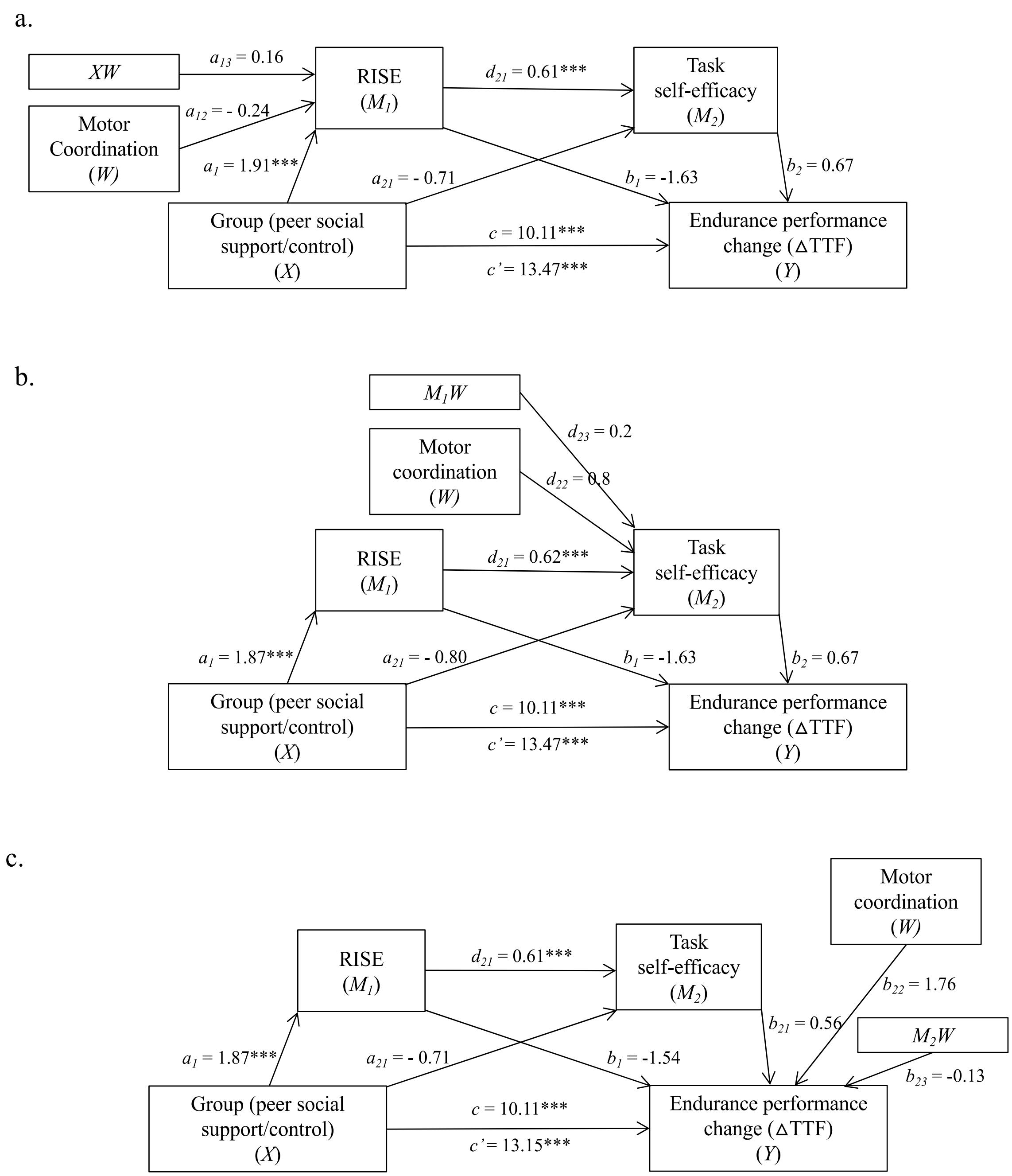

Figure 4. Moderated mediation models with motor coordination as a moderator at each level of the sequential mediation pathway: (a) from group to RISE, (b) from RISE to task self-efficacy, and (c) from task self-efficacy to endurance performance change. No evidence for a moderating effect in any model. (* $p < .05$, ** $p < .01$, *** $p < .001$).

DISCUSSION

This study investigated the effects of peer social support on RISE, task self-efficacy, and physical performance in youth with a secondary analysis based on variations in children's motor coordination abilities. It was hypothesized that a peer providing social support prior to a challenging physical task would lead to higher RISE and task self-efficacy as well as maintained or improved physical performance compared to when peer social support was not provided. It was also predicted that peer social support would lead to improved physical performance through changes in RISE and task self-efficacy through a sequentially-mediated process. Lastly, it was hypothesized that motor coordination would moderate the RISE—task self-efficacy—performance relationship such that children with lower motor coordination would show smaller effects of peer support on performance compared to those with greater motor coordination.

Peer Social Support and Efficacy Perceptions

Consistent with the first hypothesis, children in the peer social support group reported higher RISE perceptions. This finding indicates participants who were exposed to peer social support thought their peer partner was more confident in their ability to endure longer on the second endurance handgrip squeeze compared to those in the control group who had lower perceptions about their peers' belief in their ability. This finding is in line with previous qualitative research findings indicating positive interactions, in which others verbally or non-verbally express their belief in one's ability, contribute to RISE beliefs (Graham & Bray, 2014; Saville et al., 2014). Higher RISE beliefs can be beneficial for youth in sport as RISE has previously been found to be positively associated with sport enjoyment and continuation in sport in youth (Jackson et al., 2014). This is an important finding as it demonstrates a single exposure to supportive feedback from a peer can have a very large effect on RISE beliefs.

Although peer social support was associated with higher RISE, it was not associated with higher scores for task self-efficacy. However, it is important to note that task self-efficacy trended toward being higher in the peer social support group with a small-to-medium sized effect. It is also important to acknowledge that within the whole sample (see Table 3c), RISE and task self-efficacy were moderately-strongly correlated ($r = .57$), suggesting that when children perceive others to have high beliefs in their abilities (RISE), they also believe more strongly in their own abilities.

The lack of association between peer support and task self-efficacy was contrary to hypotheses; however, it is possible the social support manipulation did not significantly influence self-efficacy because the support was from a peer who had little experience with the handgrip task rather than a person of higher power or skill. Bandura (1997) suggests people are more likely to believe performance feedback when it comes from someone who is skilled; yet Bandura also acknowledges that vicarious experiences are more powerful sources of self-efficacy when the person being observed shares greater similarities with them. Lent & Lopez (2002) suggest the effects of RISE might be most beneficial when based on perceptions relating to persons of higher power, such as a coach or a parent, compared to a peer due to perceptions surrounding the reliability of the support. Research testing these theoretical propositions has not been supportive, as results demonstrate stronger associations between peer-focused RISE and self-efficacy compared to coach-focused RISE and self-efficacy in physical activity contexts (Jackson et al., 2014). More research on this issue is clearly required; however, it seems possible that when feedback or support comes from a peer who is also viewed as highly skilled, it may have stronger effects on both RISE and self-efficacy. Future research should investigate if beliefs about the supporter's ability (other-efficacy) influences the effect of RISE on self-efficacy as it is possible RISE is more influential on self-efficacy when other-efficacy is also high. It would also be informative to conduct research that directly compares the effects of social support from a peer compared to a coach on RISE and self-efficacy for challenging physical tasks.

Peer Social Support and Physical Performance

As hypothesized, there was a significant positive change in endurance performance in the peer social support group demonstrating a large positive effect of peer social support on physical performance compared to participants who did not receive peer support. This finding aligns with previous research showing positive effects of comparative feedback (e.g., Avila et al., 2012; Gonçalves et al., 2018) and in-task verbal encouragement (e.g., Puddefoot et al., 1997), both of which are forms of social persuasion, on physical task performance in youth. The present study extends previous findings demonstrating a positive effect of peer social support, another form of social persuasion, on physical performance in children.

In addition to the effect of peer support on performance, it is also interesting to note that there was a small positive change in endurance performance in the control group. This finding was unexpected as a positive change in performance in the control group indicates there was no negative effect of the high cognitive demand task on physical performance. To elaborate, this finding is inconsistent with a large body of research that demonstrates high cognitive demand tasks lead to decreases in physical performance (for reviews see Brown et al., *under review;* Englert, 2016, Pageaux & Lepers, 2018), including isometric endurance handgrip squeezes (e.g. Bray, Martin Ginis, Hicks, & Woodgate, 2008). While this effect has primarily been found in young adults, the study by Graham et al. (2018) examined the effect of high cognitive demand tasks in children of similar age to the sample in this study and found children who performed a high cognitive demand task, specifically the Stroop task, experienced a significant decrease (d = .82) in physical performance on an endurance handgrip squeeze (Graham et al., 2018).

Although these findings were not consistent with Graham et al.’s (2018), it is important to acknowledge there were some methodological dissimilarities between the studies. For instance, participants in Graham et al.'s (2018) study engaged in all tasks individually, while in this study participants completed the experimental tasks independently but were recruited and brought to the lab in pairs, which may have unintentionally prompted them to try harder on both tasks (i.e., social facilitation). In this study, participants in the control group were also asked to rate their RISE perceptions as they related to the other child in their dyad. While this procedure was necessary to compare RISE between the experimental groups, it could have also heightened participants' attention to the beliefs of others, which may have increased arousal or motivation to perform better on the task despite the fact that there was no verbal exchange between peers as there was in the experimental condition. Lastly, the participants in this study were more confident in their handgrip endurance abilities than the sample in Graham et al. (2018). Specifically, the participants in this study who completed the high cognitive demand task and did not receive peer support reported higher task self-efficacy ($M = 5.78 \pm 2.41$) compared to participants in their sample who completed the same high cognitive demand task and also did not receive peer support ($M = 3.40 \pm 1.19$). Thus, differences in methodologies and in the samples could explain why participants in our control group did not show the expected decline in physical performance that is seen following high cognitive exertion.

Indirect Effect of Efficacy Perceptions on Physical Performance

Our primary interest in this study was to investigate the independent effects of peer support on RISE, self-efficacy and task performance. However, given the theorized causal processes proposed by Lent and Lopez's (2002) tripartite efficacy model, we also explored the hypothesis that changes in endurance performance resulting from peer social support would be mediated by RISE and task-self efficacy. Contrary to theory, we did not find evidence for either independent or sequential indirect effects of RISE and task self-efficacy on performance. Rather, despite a strong direct effect of peer social support on physical performance, results showed peer social support was associated with higher RISE and higher RISE was associated with higher task self-efficacy, but these perceptions did not go on to predict changes in endurance performance.

Previous research exploring RISE and self-efficacy in physical education settings has also failed to find a direct effect of either RISE or self-efficacy on physical performance (Jackson et al., 2014; Jackson, Myers, et al., 2012). In undergraduate kinesiology students, Jackson, Myers, et al. (2012) found no direct effect of instructor-focused RISE on achievement on the end-of-semester performance assessment, however they did find RISE was indirectly predictive of achievement through self-efficacy and enjoyment, sequentially. In a second study, Jackson et al. (2014) measured instructor-focused and peer-focused RISE in a similar undergraduate kinesiology student sample. They found no direct effect of instructor-focused RISE or peer-focused RISE on achievement, but did find RISE to be predictive of achievement indirectly through self-efficacy (Jackson et al., 2014). Given the discrepancies between these studies and the current study, in terms of both the samples and the performance outcome measures, there are clearly a number of factors that could account for differences in findings. Further research investigating the theorized causal processes by which social support and RISE affect self-efficacy and performance in the physical activity domain is needed.

Although our findings led us to conclude that increases in endurance performance in the peer social support group were not a result of higher RISE or self-efficacy perceptions, it is important to acknowledge alternative mediating variables that could be considered for future study. One possibility is that peer social support could have influenced physical performance through perceptions of affect, efficacy, or exertion that occurred during the task, but were not accounted for by the pre-task measures. In support of this interpretation, a study by Hutchinson, Sherman, Martinovic, and Tenenbaum (2008) manipulated self-efficacy in university students prior to an endurance handgrip squeeze. Self-efficacy was manipulated by providing false normative feedback indicating much better than average performance, much worse than average performance, or no normative feedback. Self-efficacy was higher in the group that received positive feedback compared to no feedback and negative feedback groups. Participants with higher self-efficacy endured longer on the handgrip squeeze and this was accompanied by higher in-task determination, higher affective states at the beginning of the handgrip squeeze, and lower perceived exertion during the handgrip squeeze compared to participants with lower self-efficacy (Hutchinson et al., 2008). The main difference between the present study and Hutchinson et al.'s (2008) study was the type of social persuasion provided. In their study, participants were provided false comparative results of their previous performance, whereas in this study participants were provided verbal encouragement without any performance feedback. Participants in our study did not differ in pre-task affect nor in post task perceived exertion (see Table 1); however, the findings of Hutchinson et al. (2008) suggest perceptions may have differed once the physical task began and throughout the duration of the task, which could have contributed to the observed performance differences.

In the present study, task self-efficacy was assessed at only one time point, prior to performance of the second handgrip task, therefore it also seems possible that self-efficacy perceptions during the task may have decreased as the task became increasingly more difficult; especially for those who did not have the additional motivation from their peer's support. Bandura (1997) suggests information that could influence self-efficacy is only beneficial when it is attended to and internalized. Participants in the peer social support condition may have recalled and relied on RISE throughout the task to remind themselves of the support they received and of their own capabilities. Future research should explore in-task affect, exertion, and self-efficacy perceptions during physical tasks following cognitive tasks in youth.

This study did not fully explore Bandura's (1986) SCT as there was no measure of outcome expectations and changes in efficacy perceptions were not assessed. The discordance between efficacy perceptions and performance could be explained with consideration given to perceptions regarding past performance and expected outcomes of future performance. More specifically, RISE is suggested to be most influential when learning new skills (Lent & Lopez, 2002) and after performance setbacks occur (Lent, 2016). Therefore, if participants perceived their first performance to be a failure, they may have focused more on RISE when forming their self-efficacy perceptions compared to those who viewed their first performance as a success. To account for this possibility, participants could have been queried about how they viewed their performance on the first handgrip trial (i.e., as a success or a failure). In addition, Bandura (1997) theorizes when past performances are reflected on, reasons attributed to why the outcome arose could influence future performance through changes in efficacy perceptions. To account for efficacy perceptions after the first performance, participants could report RISE and task self-efficacy for a hypothetical second attempt immediately following the first handgrip trial in order to get an estimate of efficacy perceptions prior to any experimental manipulations. Using a measure of change in efficacy perceptions could have been more accurate since Bandura (1997) recommends controlling for past efficacy perceptions if also controlling for past performance. The performance outcome measure (ΔTTF) used in this study accounted for performance on the first handgrip trial but the measures of efficacy perceptions did not account for efficacy perceptions regarding the first trial and this may explain why self-efficacy was not predictive of performance change. Future research should use a design to explore the effect of peer social support on endurance performance change indirectly through *change* in efficacy perceptions.

Another possible explanation for changes in physical performance resulting from peer social support could be differences in muscle activation patterns that did not reach the conscious perceptual level. Previous research exploring the effect of high cognitive demand on physical performance, specifically isometric endurance handgrip squeezes, has used electromyography to measure muscle activation of the hand and wrist flexor muscles (Bray et al., 2008; Brown & Bray, 2017a; Graham, Sonne, & Bray, 2014). In both studies, muscle activation was higher and endurance time was lower during a handgrip squeeze following a high cognitive demand task compared to following a low cognitive demand task (Bray et al., 2008; Brown & Bray, 2017a). Interestingly, Brown & Bray (2017a) provided monetary incentives for performance to half of the participants and found that muscle activation and endurance time for participants who completed the high cognitive demand task and received incentives did not differ from those who completed the low cognitive demand task. The authors suggest these muscle activation pattern as a potential mechanism through which this group of participants was able to improve performance rather than experience performance deficits as expected (Brown & Bray, 2017a). Since monetary incentives and support from peers may have similar beneficial effects on motivation, peer social support may have similar effects on endurance performance through decreasing muscle activation patterns.

Lastly, peer social support could have impacted physical performance through altering brain activation patterns. Recent research using brain imaging techniques (e.g., electroencephalography and functional near-infrared spectroscopy) demonstrate that during tasks with high cognitive demands, including the Stroop task, brain activation in the prefrontal cortex is heightened in young adults and children (e.g., Kock, Miguel, & Smiley-Oyen, 2018; Mücke, Andrä, Gerber, Pühse, & Ludyga, 2018; Pires et al., 2018). In addition, Pires et al. (2018) found that the heightened prefrontal cortex activation carried over into physical performance and was associated with a decrease in cycling performance. If it is increased brain activation patterns driving decreases in performance, peer support may have influenced performance through altering brain activation patterns. Prefrontal brain activation may have been higher than baseline following the high cognitive demand task and peer social support may have had a buffering effect reducing brain activation to lead to improved physical performance.

In a study examining the effect of peer support on brain activation patterns, higher quality daily social support was correlated with lower activation of the dorsolateral anterior cingulate cortex and Brodmann area 8, regions associated with stress response, during a socially stressful task (Eisenberger, Taylor, Gable, Hilmert, & Lieberman, 2007). In addition, there were no correlations between self-reported distress and activity in these brain regions. Although their study did not assess physical performance, the findings suggest social support may influence brain activation patterns that could have downstream effects on performance (Eisenberger et al., 2007). The subjective measure of mental fatigue used in the present study may not have captured differences that could have occurred in prefrontal cortex activation and influenced performance. Future research should employ brain imaging techniques in addition to self-report measures to more thoroughly examine the effects of social support on physical performance.

Role of Motor Coordination

We hypothesized motor coordination abilities would be a moderating factor in the relationship between peer social support on endurance performance change. We found no conditional effect of motor coordination on RISE and self-efficacy perceptions, corroborating a previous finding indicating no difference in task self-efficacy for children with higher verses lower motor coordination abilities (Graham et al., 2018).

Results also showed no moderating role of motor coordination on the effect of group on endurance performance change. This finding suggests children in the peer social support group, regardless of motor coordination abilities, experienced improvements in physical endurance performance compared to children in the control group. This finding contradicts previous research showing that children with lower motor coordination experienced larger decreases in endurance performance following high cognitive demand exertion compared to more coordinated children (Graham et al., 2018). However, Graham et al. (2018) grouped children into lower verses higher motor coordination abilities based on a median split of standardized BOT-2 scores. Due to the differences in means between our sample and theirs, and to increase power (Hayes, 2018), we tested motor coordination abilities as a continuous, rather than an artificially categorized, variable in our moderation analysis. When analysing BOT-2 scores as a continuous variable, there was no moderating effect in our sample. Moving forward, to study the effect of social support on children with low verses high motor coordination abilities, researchers are encouraged to recruit based on motor coordination in order to create distinct groups or to obtain a more evenly distributed sample.

We further explored the potential moderating effect of motor coordination abilities by testing it as a moderating factor at each step of the hypothesized sequential mediation pathway. We did not find support for a moderating effect of motor coordination for any of these pathways. Overall, the results indicate peer social support has a beneficial effect on RISE as well as on performance for children with a range of motor coordination abilities. In addition, regardless of motor coordination ability, peer social support had no indirect effect on physical performance through RISE and task self-efficacy.

Strengths and Limitations

The results of this study provide evidence for the beneficial effect of peer social support on efficacy perceptions and physical performance in youth but should be considered with several important strengths and limitations in mind. Firstly, this was a lab-based study which importantly allowed for the isolation of support coming from a single peer and offered the potential to draw causal inferences; which has not been accomplished by any study investigating relationships between RISE, self-efficacy, and performance to date. The controlled experimental environment also minimized external factors that may have influenced performance such as spectators, visual distractions, or different temperatures.

It must also be acknowledged that, as a lab-based study, the findings are not generalizable to environments in which children more typically engage in sport and exercise behaviours. In addition, the task used to assess physical performance was selected as one that participants would not be familiar with, thus is not similar to tasks children commonly perform when participating in sport. As a result, the handgrip endurance performance measure may not have captured participants' true maximal performance abilities due to its novelty. Future research should explore how peer social support may impact sport-based physical activities that children are more familiar with or tasks with some direct application to sport skill acquisition or performance (e.g., practice drills, fitness-developing exercise).

The findings from this study are also not generalizable to other populations. Specifically, participants were recruited from a summer sports camp. Accordingly, this sample of children likely do not represent the general same-age population who may be less likely to engage in sport and physical activity and may differ in their physical performance and efficacy perceptions regarding physical tasks. Participants were also recruited based on convenience sampling, suggesting the participants were motivated to voluntarily take part in this study. While this potentially heightened level of motivation could be seen as an advantage, it also suggests the sample may not be representative of a larger population with different levels of motivation. The findings also cannot be generalized to younger or older populations. Specifically, these findings cannot be generalized to a young adult population in which the negative effects of highly demanding cognitive tasks on physical performance has been consistently documented in past research (Van Cutsem et al., 2018). Future research should explore the effects of social support within the cognitive demand to physical performance paradigm in different populations.

Another limitation of this study was the experimental design. This study included two groups: peer social support and a control group with no support, both exposed to the high cognitive demand task. Previous research within the cognitive demand to physical performance literature commonly compares the effect of high cognitive demand task verses low cognitive demand (or control) task on physical performance (e.g., Bray et al., 2008). A more thorough study design would include randomizing participants within a full 2 (peer social support vs. no support) x 2 (high cognitive demand vs. low cognitive demand) factorial design where the no support + low cognitive demand group would serve as a more controlled comparison group. By including groups in which the low cognitive demand task was performed, it would have been possible to explore the potential differential and interaction effects of high cognitive demand and peer social support on physical performance. Future research should explore these effects using a 2x2 factorial design.

The application of these findings to real-world scenarios is also limited. Although participants providing support were given some autonomy in the phrases of support they gave, the prepared words may still have been perceived as inauthentic. Participants who received support reported higher perceived social support compared to those who did not receive support, however the difference between groups was marginal. Lent and Lopez (2002) largely focused on the impact of interactions with close others, whereas participant dyads in this study could have known each other for as little as two days. It would be of interest to compare the effects of social support on physical performance and efficacy perceptions when support is provided by a close friend compared to when support is provided by a new peer.

Conclusion

This study is the first to explore the effects of peer social support on physical performance and efficacy perceptions in youth in an experimental setting. Although peer social support was associated with higher RISE and improved physical performance, the mechanism through which social support influences physical performance remains unclear. In addition, motor coordination did not appear to influence the effect of peer social support on physical endurance performance. Overall, the findings provide evidence for beneficial effects of peer social support on both efficacy perceptions and physical performance.

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APPENDIX A

McMaster University
Inspiring Innovation and Discovery

LETTER OF INFORMATION
(For parents or guardians regarding their child's participation)

"They believe I can do it … maybe I can!" The effects of interpersonal feedback on relation-inferred self-efficacy (RISE), self-efficacy, and intrinsic motivation in children's sport.

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Hamilton, Ontario, Canada

Although some of the most powerful influences on our self-confidence come from the personal experiences, we have performing tasks, most of us can recall instances when we felt or knew that other people believed we could do it. These beliefs may be very important when we are learning new skills or when we doubt our own abilities after setbacks.

Purpose of the Study: Our main goal is to learn how performance on cognitively challenging tasks can change confidence and subsequent exercise performance. We also want to learn how verbal support from peers can boost confidence and, in turn, help children overcome the effects of cognitive/mental fatigue. We are very interested in learning from *your child`s experiences while learning sport skills in the Sport and Fitness School* to understand how they respond to the things their peers do or say that might make them feel more confident in their abilities to learn, put forth their best efforts, and perform sport skills.

Procedures involved in the Research: The study will take place in the Exercise and Health Psychology Laboratory in the Ivor Wynne Centre at McMaster and will involve approximately 45 minutes of your child's time. We will make arrangements for your child to participate at a time that is convenient for you: during SFS, after an SFS day, or an alternative time outside of SFS altogether. Your child will participate with a peer who is also involved in the SFS. Participants will complete a brief paper and pencil survey of their physical activity experiences at home, in organized sport, and at school. They will then perform a standardized motor skills assessment. This test is called the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) and is an assessment they may have had done at school. It involves some basic tasks such as hopping, jumping, and walking a balance beam. The BOT-2 will take about 10 minutes to complete. The remainder of your child's time (about 25 minutes) will be devoted to a brief experiment in which your child will be invited to perform an effortful muscular endurance task that will involve holding a tight handgrip squeeze on a pressure-sensing device. After his/her first attempt at the task, your child will be randomly selected to complete either a cognitively challenging task or an easier version of that task for 5 minutes. The cognitively challenging task is called a Stroop task and it will require your child to identify different colours. In the mentally challenging version of the task, your child will be presented with lists of colour words but the ink colour of the word will be inconsistent with the word (e.g., the word *red* will be presented in *green* ink). The goal of the task is to say the colour they see without reading the word. In the easier version of the task, the words and ink colour are the same (e.g., the word *red* is presented in *red* ink). After the Stroop task, they will complete a second handgrip-squeezing task.

Depending on the experimental condition your child is allocated to, they will either engage in a peer support activity or not. In the peer support condition, both children will prepare 2-3 brief phrases consisting of encouraging words such as "I believe you are going to do really well on this task" and say those phrases to each other prior to performing the second handgrip-squeezing task. Both children will have an opportunity to say the support phrases to their peer and listen to their peer say the phrases to them. At least two researchers or SFS instructors will be present during the study at all times for the safety and assurance of all involved.

Potential Harms, Risks or Discomforts: There is the possibility of falling during the balancing and jumping tests, but the risk is no greater than would be involved when participating in the activities of the SFS or sports in general. There may be some residual muscle fatigue or discomfort experienced after performing the handgrip squeezing tasks, but these should also be no greater than would be involved when participating in the activities of the SFS or sports in general. After performing the tasks, children will do some light stretching and be provided with a cold pack to apply to their forearm if they wish to do so. The cognitively challenging version of the Stroop task is designed to be difficult and mistakes are often made. However, prior to performing the Stroop task, participants will be told that the task is designed to be hard, that it is not a test, to try their best, and if at any point they wish to stop they can. It is possible that your child could feel uncomfortable about providing verbal support to their peer. If this is the case, your child can opt out of that portion of the study and continue participating. At the end of the experimental session, the experimenters will debrief your child to ensure that s/he understands his/her performance during the experiment was exemplary and that s/he played a very important part in this study.

Potential Benefits: There are no direct benefits to you or your child from taking part in this study aside from learning about how children may respond to feedback they receive from their peers. The results from this study will help the scientific community better understand the ways in which information shared between people can contribute to enhancing self-confidence in youth sport participants.

Confidentiality: Any information that is obtained during this study will not be attributed to your child personally. Anything that we find out about your child that could possibly identify them will remain confidential and will be disclosed only with your permission. Your child's privacy will be respected. The background information surveys are completely private and will be kept in a locked filing cabinet in the Health and Exercise Laboratory for a period of five years. Your child's name will not be recorded on any of the study documents. Only the researchers will have access to this information. Your child's identity will <u>never</u> be revealed in any reports of this study.

Honorarium: As a token of our appreciation for your child's participation in the study, s/he will be given a $15 gift card from Indigo/Chapters bookstore.

Participation and Withdrawal: You and/or your child can decide whether to take part in this study or not. If your child volunteers for this study they may withdraw at any time during the course of the study session or afterwards without penalty. If your child wishes to withdraw from the study during the scheduled study session, we may contact you prior to the arranged pickup time. However, in any case, your child will be cared for by research or SFS staff until you pick them up. You or your child can choose to remove his or her data from the study at any time, but please bear in mind that we expect to publish results from the study around January 1, 2019 and once reports are formally published it won't be possible to remove the data from the results in already published findings. However, future reporting of the study's results will not include your withdrawn data. Your child may also refuse to answer any questions s/he does not want to answer or refuse to engage in any of the experimental tasks while remaining in the study. Your child will still receive the honorarium even if s/he does not complete the full study.

Information about the Study Results: We expect to have this study completed by the end of September, 2018. If you would like a brief summary of the results, please leave me your contact information on this consent form.

Questions about the Study: If you or your child have questions or require more information about the study itself, please contact the principal investigator, Dr. Steven Bray.

This study has been reviewed by the McMaster University Research Ethics Board and received ethics clearance. If you have concerns or questions about your rights as a participant or about the way the study is conducted, please contact:

McMaster Research Ethics Secretariat
Telephone: (905) 525-9140 ext. 23142
c/o Office of Research Services
E-mail: ethicsoffice@mcmaster.ca

CONSENT FORM

I have read the information presented in the information letter about a study being conducted by Dr. Steven Bray of McMaster University. I have had the opportunity to ask questions about my child's involvement in this study and to receive additional details I requested. I understand that if my child agrees to participate in this study, s/he may withdraw from the study at any time. I have been given a copy of this form and I permit my child to participate in the study. By providing my consent for my child's participation in this study, neither my child nor I have waived any rights to legal recourse in the event of research-related harm.

Name of parent/legal guardian (Printed) ____

Signature: ____

Child's name: ____

Child's date of birth: ____

SFS group: ____

1. Follow-up Summary

☐ Yes, I would like to receive a summary of the study's results. Please send them to this email address ____________________________________ or to this mailing address

____.

☐ No, I do not want to receive a summary of the study's results.

2. I agree to be contacted for future sport an exercise studies, and understand that I can always decline the request.

☐ Yes. Please contact me at:

____

☐ No.

Emergency/Participant Withdraw Contact Information

Study Investigator: Dr. Steven Bray
Study Title: "They believe I can do it … maybe I can!" The effects of interpersonal feedback on relation-inferred self-efficacy (RISE), self-efficacy, and intrinsic motivation in children's sport.

By signing this log, I give permission for the researcher to contact me, via telephone, in the event of an emergency or if my child chooses to withdraw during the study.

___________________________________ ____

(Signature) (Phone # and email address)

McMaster University

Inspiring Innovation and Discovery

Assent Form for Minor to Participate

"They believe I can do it … maybe I can!" The effects of interpersonal feedback on relation-inferred self-efficacy (RISE), self-efficacy, and intrinsic motivation in children's sport.

Your parents are letting me to talk to you about a project that I am working on with a couple of other people. The project is on confidence in sports. I am going to spend a few minutes telling you about our project, and then I am going to ask you if you are interested in taking part in the project.

Who are we? My name is Kira and I am a researcher at McMaster University. I work in the Department of Kinesiology where we learn how the human body and mind work together during sports and exercise.

Why are we meeting with you? We want to tell you about a study that involves children like yourself. We want to see if you would like to be in this study too.

Why are we doing this study? We want to find out how other people like your friends or siblings could make you feel more confident in yourself when you play or are learning sports skills.

What will happen to you if you are in the study? If you decide to take part in this study there are some different things we will ask you to do. In the first part of the study, we will ask you to answer some questions on paper. Then you will do a series of jumping and balancing skills. In the second part of the study, we will ask you to squeeze a handle with your hand. You will do the squeezing tasks twice and have a chance to practice it again if you would like to at the end of the experiment. Also, after the first squeezing task you will complete a task which requires you to identify different colours. I will also give you some instructions about your hand squeezing performance and we will ask you to answer some questions about how you felt after the instructor talked with you. It will take you about 45 minutes to do all of these things.

Are there good things and bad things about the study? What we find in this study will be used to help us understand what you, your friends, and your siblings can do to make each other feel like good players. As far as we know, being in this study will not hurt you and it will not make you feel bad. The jumping and balancing tests we ask you to do should not be harder than the sports you are playing, but if you feel unsafe please tell us and you can stop. The hand squeezing tasks might make your muscles feel tired or stiff later today or tomorrow. We will do some stretching at the end of the study and give you a cold pack to put on your arm if you feel your muscles are a bit sore.

<u>Will you have to answer all questions and do everything you are asked to do?</u> If we ask you questions that you do **not** want to answer then simply don't answer those questions. If you do not wish to do the hand squeezing or the colour task then simply tell us and you will not have to do them.

<u>Who will know that you are in the study?</u> The things you do and anything you write about will not have your name with it, so no one other than us will know your answers to questions or what you did during the hand squeezing tasks.

The researchers will not let anyone other than themselves see your answers or any other information about what you did in the study.

<u>Do you have to be in the study?</u> You do not have to be in the study. No one will get angry or upset with you if you don't want to do this. Just tell us if you don't want to be in the study.

And remember, if you decide to be in the study but later you change your mind, then you can tell us you do not want to be in the study anymore.

<u>What do you get for being in the study?</u> As a thank you for being in the study we will give you a $15 gift card to spend at Indigo/Chapters on a new book or something else you would like.

<u>Do you have any questions?</u> You can ask questions at any time. You can ask now or you can ask later. You can talk to me or you can talk to someone else at any time during the study. Here are the telephone numbers to reach us.

Dr. Steven Bray, Department of Kinesiology (905) 525-9140 Ext. 26472

IF YOU WANT TO BE IN THE STUDY, SIGN YOUR NAME ON THE LINE BELOW:

Child's name, (Print your name on this line): ______________________________

Date: ____________________________

Signature of the professor/student researcher:

______________________________ **Date:** ________________________

MENTAL FATIGUE VISUAL ANALOGUE SCALE

Please mark (X) on the line the point that you feel represents your perception of your current state of **MENTAL FATIGUE**.

None at all 0 ____ 100
Maximal

AFFECT

Please report the number below that corresponds to how you feel <u>at this moment.</u>

+5 Very good

+4

+3 Good

+2

+1 Fairly good

0 Neutral

-1 Fairly bad

-2

-3 Bad

-4

-5 Very bad

RATING OF PERCEIVED PHYSICAL EXERTION

Please report the number below that corresponds to how much *physical* effort that task required.

0	Nothing at all
0.3	
0.5	Extremely weak
1	Very weak
1.5	
2	Weak
2.5	
3	Moderate
4	
5	Strong
6	
7	Very Strong
8	
9	
10	Absolute Maximum

RATING OF PERCEIVED MENTAL EXERTION

Please report the number below that corresponds to how much *mental* effort that task required.

0	Nothing at all
0.3	
0.5	Extremely weak
1	Very weak
1.5	
2	Weak
2.5	
3	Moderate
4	
5	Strong
6	
7	Very Strong
8	
9	
10	Absolute Maximum

INCONGRUENT STROOP TASK EXAMPLE

RED	RED
BLUE	GREEN
GREEN	GRAY
BLUE	YELLOW
BLACK	PINK
YELLOW	ORANGE
GREEN	BLUE
ORANGE	GREEN
GREEN	BLUE
RED	RED
PINK	GREEN
BLACK	YELLOW
BROWN	ORANGE
YELLOW	BLUE

RELATION-INFERRED SELF-EFFICACY

I think my peer is confident that I can...	Yes or No	How confident do you think they are?
Hold the handgrip for almost as long as last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for as long as last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for a little bit longer than last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for a lot longer than last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely

TASK SELF-EFFICACY

I am confident that I can...	Yes or No	How confident are you?
Hold the handgrip for almost as long as last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for as long as last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for a little bit longer than last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely
Hold the handgrip for a lot longer than last time		0 1 2 3 4 5 6 7 8 9 10 Not at all Completely

PERCEIVED SOCIAL SUPPORT

1. I feel my friend is supportive of me in performing this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

2. I feel my friend has confidence in me to perform well on this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

3. I feel my friend would be happy for me if I perform well on this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

4. I feel my friend believes in my ability to succeed at this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

5. I feel my friend would want me to perform well on this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

6. I feel my friend thinks that I can do well on this task.
   definitely not *unlikely* *maybe* *probably* *definitely*

DEBRIEFING SCRIPT
(For participant)

- *That's the end of the* study. *I would like to thank you for participating in all the different activities we had you do today*.

- *The information you've given us and your performances on all of the different tasks today will help us learn more about the you and your friends can increase the confidence of athletes your age. Eventually this information will be used to teach future SFS instructors and coaches and parents how to help young people learn how to be supportive of each other to keep each other involved in different sports and recreational activities for many years to come.*

- *Your parent(s) should be here now/ your next SFS activity will be starting, so we can go now to our meeting place*.