Children's Ability to Navigate Competitive Contexts: The Role of Gender and Socio-Cognitive Skills

by

Nicole Simone Gevaux

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

A crucial aspect of children's development is learning to navigate the diverse contexts within their social world. Competitive contexts are unique in that individuals must attempt to perform well or win, but also maintain social relationships with peers or competitors. This study assessed how the context (winning/tying/losing), gender, and socio-cognitive skills affected children's game play and communication with opponents. Four- to six-year-old children (*N*= 102) played a rigged game on an electronic tablet against fictional peers (who participants believed were real children). Children sent verbal messages to their opponents after receiving feedback that they had won, tied or lost. Children's performance in the game improved after receiving feedback that they had won or tied previous games but did not improve after feedback that they were losing. Girls performed better on the competitive game than boys, regardless of context. Girls with higher executive functioning abilities showed more improvement in their performance after receiving feedback that they were winning. Better theory of mind abilities predicted better game play performance for both genders, regardless of perceived outcome. In a losing context, boys' messages to opponents on the final trial showed more pro-social content than girls. Moreover, girls became continuously less pro-social towards their opponents after feedback that they were losing. Older children displayed higher levels of pro-social behaviour regardless of context. This research provides new insights into how context, gender and socio-cognitive skills influence pre-schooler's performance and social behaviours in a competitive environment.

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Literature Review

An important aspect of children's development is learning to navigate diverse situations within their social world. To become socially competent, children must learn to adapt their behaviours so that they can function effectively in the different social contexts they encounter. Many different factors dictate which behaviours are appropriate for a particular social interaction, such as the context and social partner. Beginning in infancy, children show sensitivity to variations in their social environments (Elkins, 2016; Markova & Legerstee, 2006), though their ability to engage effectively within various contexts shows development throughout the preschool and school age years, and may progress in concert with the development of other socio-cognitive skills (Ciairano, Visu-Petra, & Settanni, 2007; Wellman & Liu, 2004).

The purpose of this literature review is to outline the nature of social competence and how it develops, with a particular focus on children's behaviour within competitive contexts in terms of both performance outcomes and maintaining social relationships. This review will discuss the development in children's ability to understand the nature of competitive environments, their reactions to success versus failure, and gender differences in behaviours in competitive environments. Finally, children's socio-cognitive skills, specifically executive functioning and theory of mind abilities, in relation to their behaviour in such contexts will be reviewed.

Social Competence

Social competence can be defined as the ability to use behavioural, cognitive, and affective skills to flexibly adapt to various social situations and norms, based on the environmental context (Bierman & Welsh, 2000). A popular way of thinking about socially competent behaviour is that it entails merely friendly, cooperative, or socially desirable acts (Eisenberg & Mussen, 1989). While social competence and prosocial behaviour are linked in many ways, prosocial actions are not always the most appropriate in certain contexts, due to the diversity of expectations and demands in different social situations. To behave in a socially competent way, children must learn to think through and then complete a series of different actions in any given social interaction. Being able to interact with others appropriately in varying environments requires the coordination of many actions, such as attending to cues in the environment and one's social partner to accurately appraise the social situation, identifying one's own and another's goals, implementing chosen actions, monitoring the environmental and social outcomes of actions, and being flexible in one's strategies (Bierman & Welsh, 2000; Rose-Krasnor, 1997). A challenge for children is that they are simultaneously trying to meet their own needs, while also maintaining positive social relationships with others.

Children's social competence is crucial to their normative development, as it affects many diverse, and important, areas of life. High levels of social competence are linked to benefits earlier in life, including school readiness and academic performance in children (Ashiabi, 2007; Denham, 2006; Wentzel & Asher, 1995). Additionally, longitudinal evidence suggests that poor social adjustment in childhood leads to continual difficulties later in life, such as dropping out of school, criminal behaviours, externalizing and internalizing problems (Hymel, Rubin, Rowden, & LeMare, 1990; Parker & Asher, 1987). To be able to develop adequate social competence to meet the diverse demands of the social world, children benefit from the support of various cognitive, emotional, and behavioural skills.

There are a number of social contexts that children encounter that can be categorized as those of cooperation versus competitions. Cooperative situations are contexts in which the individuals involved have convergent goals, i.e., their goals are the same as the goals of their social partners'. Social competence in a cooperative context would involve partners utilizing strategies in working together or combining their efforts in order to achieve these shared goals (Epley, Caruso & Bazerman, 2006). An example of cooperative contexts that young children frequently encounter would include working together on a group task or project in a school setting or engaging in cooperative play (e.g., playing jump rope with a peer). In contrast, competitive situations are environments in which the participating individuals have divergent self-interests or personal goals: goals that are in direct opposition to one's social partner. In this context, behaving in a socially competent manner must go alongside striving to achieve one's personal goals, and therefore winning against one's social partner (Green & Rechis, 2006). Examples of common competitive contexts that young children encounter would include competing against peers for an academic accomplishment (e.g., winning a spelling bee) or engaging in competitive games (e.g., playing soccer against another team). Regardless of their context- dependent personal goals, children are encouraged to endeavour to maintain positive relationships with their peers, both when the context is cooperative or competitive (Green & Rechis, 2006; Putallaz & Sheppard, 1992). Maintaining these positive relationships and therefore social competence can be easier when one shares their goals with a social partner, making competitive contexts potentially more difficult for children to learn to navigate effectively.

Navigating Competitive Environments

From an evolutionary standpoint, it is speculated that competitive environments arose from the necessity to obtain resources that promoted survival, growth and reproduction. This was especially true in environments where desirable resources were limited. The ability to compete for resources is an important adaptive ability of all creatures with an inherently social nature, therefore behaving competitively has evolutionary advantages within society (Charlesworth, 1996). In cooperative contexts, where social partners have convergent goals, the ability to be pro-social is linked to cooperative behaviour and therefore social competence in a straightforward manner (LaFreniere, 1996). However, in competitive contexts, behaving in an entirely pro-social manner may come at a personal cost, for example by sharing valuable resources with an opponent resulting in less for oneself. Furthermore, in some situations behaving in a pro-social manner towards others (e.g., purposefully giving the ball to someone on the opposing team during a competitive soccer game) would be deemed socially inappropriate by one's peers or teammates. Competitive situations offer a unique paradigm which may be more difficult to navigate in a socially competent way, due to the fact that both opponents are working individually to try to win or succeed at the task, while also following a pre-determined set of social rules and trying to maintain the relationship (Johnson, Maruyama, Johnson, Nelson, & Skon, 1981).

Competitive games can be described as dual-level normative structures, which encompasses a regulation of competition within a cooperative structure (i.e., both players must abide by a set of agreed upon rules for the game to function; Schmidt et al., 2016). Competitive contexts have specific rules governing the behavior of social partners within that environment, which are referred to as constitutive rules. These rules outline the idea that "fair play" is necessary to engage even in the most intense of competitive situations. For example, even in violent competitive contexts such as boxing or wrestling, both opponents must abide by agreed upon rules (Schmidt et al., 2016). Violating such rules during a competitive game, for example using methods such as cheating or violence, might achieve the child's desire to win. However, that success could come at great cost to the relationship with their opponent, with repercussions extending far beyond the end of the game. Therefore, respecting the rules and social scripts governing competitive environments is an integral part of developing social competence. In order for children to both succeed at their task and to maintain social relationships, these goals must be mutually considered and balanced in competitive environments. Learning the skills of negotiation and effective conflict management strategies, or the ability to balance pro-social versus competitive behaviours, are essential to the development of social competence (Rose-Krasnor, 1997). The ability to successfully navigate competitive environments is a complex but crucial skill to learn over the course of a child's development.

Development in understanding competitive games.

The development of children's behaviour within competitive contexts is linked to a multitude of factors, including age, gender, group size, familiarity with peers and opponents, and resource scarcity (Benenson, Nicholson, Waite, Roy & Simpson, 2001; Green, Cillessen, Berthelsen, Irving & Catherwood, 2003). Socially competent children appear to learn highly successful strategies for entering peer groups and negotiating access to limited resources in competitive environments (Green & Rechis, 2006).

Around the age of three years old, children begin to show understanding of the rules and concepts of competitive games, including the concept of winning versus losing. That is, they are able to report afterwards whether they won or lost, and show appropriate emotions based on the outcome of the game (Heckhausen, 1984; Stipek et al., 1992). At this age, children begin to understand that themselves and their opponents will have different goals during competitive games (Rakoczy, Warneken & Tomasello, 2007). However, at the age of three, while children may understand that their opponent is trying to win the game, they struggle to fully understand the notion that their opponent's goal is directly in opposition to their own personal goals, or to fully understand their opponent's desires in relation to their own (Perner & Roessler, 2010; Priewasser, Roessler & Perner, 2013). It seems that at this stage, they are able to only focus on one element of competitive gameplay at a time, such as the rules, their desires to win, or the actions of their opponent, without being able to fully integrate these bases of knowledge into a comprehensive picture of what competition entails (Schmidt et al., 2016). Children continue to develop a better understanding of the nuances of competitive contexts as they age. Schmidt and colleagues (2016) found in one study that both three and five-year-olds protested when a (puppet) opponent broke the rules during a competitive game. However, five-year-olds, but not three-year olds, also protested when their opponent acted irrationally by helping them win. Therefore, by the age of five, children understand that in competitive situations that they and their opponents have mutually exclusive goals, and are not appreciative when their social partner behaves in a manner that is not fitting with the context, or breaks the constitutive rules of the gameplay (Schmidt et al., 2016). Research has shown that children place great importance on the outcomes of competitive gameplay with peers. Work by Underwood and colleagues investigated the behaviours of school-aged children (aged eight to twelve) playing a rigged competitive game on a computer, against a same-age and same-gendered confederate who made negative comments towards participants. Although most children were able to maintain some degree of composure after both losing the game and being provoked by the confederate, these elements of the gameplay led to negative reactions from the participants, shown through both self-report measures of affect and observed behavioural measures (Underwood, Hurley, Johanson & Mosley, 1999).

Children's reactions to success versus failure.

Within competitive contexts, information about how children are performing relative to their peers (i.e., winning versus losing) is made salient. Therefore, children's social behaviour within competitive contexts may be affected by their own reactions to success versus failure. Children's responses to success and failure can have large impacts on their motivation, determination, learning and performance outcomes depending on how they respond to previous feedback on their performance. Literature on responses to performance feedback in educational settings has stressed the importance of mindset or personal outlook in reactions to success and failure. Dweck proposes that children with fixed mindsets (those that believe they have a certain level of ability which cannot be changed) respond to failure with frustration, helplessness, and lower motivation to try again at the failed task. However, children with growth mindsets (those that believe that ability can be developed through hard work and learning new skills) are more likely to respond to failure with determination to try again, and are less likely to attribute academic setbacks to fixed personal states (i.e., not being "good enough"; Dweck 2013; Haimovitz & Dweck, 2017). This theory offers one possibility on how individual differences in children can change behaviours after personal success or failure.

Research studying children's responses to winning versus losing in competitive gameplay situations has aimed to explore patterns of traits in relation to behaviours when faced with success or failure. One study by Hughes and colleagues found that children (aged five to seven) with behavioural issues are more likely to respond to failure in a competitive gameplay situation with negative behaviours (e.g., violence, cheating, negative remarks), in comparison to typically developing children (Hughes, Cutting & Dunn, 2001). Similar research by Ohan and Johnston (2007) demonstrated that after winning a rigged competitive game, participants with attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD) displayed more aggression and less pro-social behaviours than typically developing peers (Ohan & Johnson, 2007). Other research by Donzella and colleagues (2000) investigating pre-schoolers (aged three to five) found that when children played a rigged competitive game against an experimenter, in which they won one round and lost one round, that children who were high on the personality trait of extraversion showed increased positive affect when winning and increased negative affect when losing, in comparison to children with lower levels of trait extraversion. Male children who were described by their teachers as low in external control abilities also showed increased cortisol responses and tense or angry affect when losing during the competitive game (Donzella, Gunnar, Krueger & Alwin, 2000). Another study by Isen and colleagues (1973) found that school-aged (fourth grade) children, after achieving success in a rigged bowling game, were more likely to engage in pro-social acts towards others, by donating a toy to a child in need. However, in the rigged failure condition, children were less inclined to make charitable donations, unless they were being observed by others. The authors speculate that being observed by their peers gave the children who lost the game the opportunity to repair their personal image by acting charitably. The results of this study suggest that success in a competitive game led to intrinsically motivated pro-social behaviours, whereas failure only led to pro-social behaviours when an external reward (peer approval) was at stake (Isen, Horn & Rosenhan, 1973). While the literature in this area demonstrates that game outcomes can influence children's behaviour when considering certain individual differences (such as behavioural issues or personality traits), there is currently very limited research on how typically developing children generally respond to success versus failure in competitive games.

Gender differences in competitive environments.

Past work has found that gender may play a role in children's preference for engaging in competitive contexts. A study by Weinberger and Stein (2008) found that when pre-school aged children (five-year-olds) were engaged in a competitive game, gender differences were found to influence behaviour, as well as whether participants were playing with mixed-gender or same-gender peer groups. Boys displayed more competitive behaviours than girls (i.e., choosing to take resources from other players as opposed to resources from a common pool), despite skill level of gameplay being consistent across genders. Girls in same-gender peer groups were found to display significantly less competitive behaviours than boys in same-gender peer groups. However, girls showed increased levels of competitive behaviours when playing against boys in mixed-gender groups, compared to when they played in same-gender groups (Weinberger & Stein, 2008). Another study found that young children (six- to seven-year-olds) who participated in a competitive computer game task showed gender differences in their main recall of the playing experience, in that the boys generally focused on the outcome of the game (whether they won or lost), while girls tended to focus more on their "friendships" fostered with the animated characters in the game (Wei & Hendrix, 2009). The findings discussed here are consistent with the general consensus in the literature that girls seem to gravitate towards playing in a cooperative nature in smaller groups, whereas boys tend to gravitate towards playing in larger groups with games of a more competitive nature (Fabes, Martin & Hanish, 2004; Jacklin & Maccoby, 1978; Maccoby, 1999). These tendencies seem to become particularly pronounced when playing with same-gendered peers, for both boys and girls. It seems to follow that boys therefore gain higher levels of exposure to competitive environments, due to self-selected preferences for types of play from a young age (Fabes et al., 2004).

Research has also demonstrated that boys and girls perform differently in competitive environments. A study of individual athletic performance in school-aged children (ten-year-olds) found that when boys raced against peers (competitive condition), their performance measured by running time improved in comparison to when they were racing alone (non-competitive condition). However, when girls raced in the competitive condition, their performance deteriorated when compared to their performance in the non-competitive condition (Gneezy & Rustichini, 2004). Another study by Weisfeld and colleagues (1982) investigating group gameplay performance found that for pre-adolescents (twelve-year-olds) engaged in a dodgeball tournament, the individual performance of female players declined when they were playing against boys, in comparison to when they played against same-gendered peers, regardless of the girls' individual skill levels. No such effects were found in boy players, who performed just as well in either condition (Weisfeld, Weisfeld, & Callaghan, 1982). These results demonstrate that when girls are obligated to engage in competition, they may be less comfortable or less motivated performing in these types of environments (and in particular mixed-gender competitive contexts) compared to boys. Children's performance outcomes in relation to success and failure in competitive contexts in terms of gender have been mainly examined in the context of physical games or athletic activities. It remains to be determined whether such differences in performance would be found in other competitive contexts, such as academic contexts or non-physical gameplay situations.

In a related field, a number of studies have found gender differences in children's reactions to success or failure in competitive environments. Nelson and Cooper (1997) found that, when school-aged children completed a computer-based task that was rigged to either result in success or failure, boys tended to attribute failures to unstable attributions that were not their doing (e.g., computer malfunctioning, not trying very hard). On the other hand, girls tended to provide unstable attributions for success (e.g., the program was easy to complete, they tried their hardest to succeed), and stable attributions for failure (e.g., they simply weren't very good at the task). Children (mostly boys) who provided unstable attributions for failure were more likely to endorse interest in completing the computer program again in the future, compared to those (mostly girls) who provided stable attributions for failure (Nelson & Cooper, 1997). Other research by Stipek and Gralinski (1991) shows that both school-aged and pre-adolescent boys tended to attribute success on achievement tests of mathematics to personal ability, and failure to bad luck. However, girls showed the opposite effects, attributing success in mathematics to luck, and poor performance to low personal abilities. Students (mostly boys) who attributed success to internal or personal reasons and failures to external or environmental reasons were more likely to endorse interest and desire to engage in mathematics tasks in the future (Stipek & Gralinski, 1991). Other research on male and female adult athletes have shown similar trends, in that fear of failure in women (and younger women in particular) was significantly attributed to a devaluing of their self-estimate in the face of failure when compared to males. These findings demonstrate that female athletes had higher internal attributions of failure (Sagar & Jowett, 2012). Other research by Manolis and Milich (1993) investigating social failure found that after completing a cooperative task with a same-gendered peer and receiving feedback that their peer did not like playing with them, girls were subsequently more affected than boys. This was shown by lower ratings of affect, and less effort in future social interactions (i.e., less time spent talking and lower friendliness; Manolis & Milich, 1993). Taken together, the literature suggests that girls may be more heavily impacted by failure in both competitive performance-based tasks and during social interactions. One possible explanation for this impact may be that girls make more internal attributions as to the reason for their failure compared to boys. If making internal attributions of failure is true for girls compared to boys across contexts, this may provide insight as to why girls in general are less likely to seek out and engage in competitive environments.

Associated Socio-Cognitive Skills

As noted earlier, developing social competence requires various cognitive, emotional and behavioural skills in order to understand and successfully adapt to the distinctions of different situations (Bierman & Welsh, 2000). Indeed, past work has found that socio-cognitive skills help facilitate the development of social competence (Devine, White, Ensor & Hughes, 2016; Razza & Blair, 2009). However, in turn, social interactions with caregivers, family members and peers can also help facilitate the development of socio-cognitive skills (Carlson, 2009; Hammond, Müller, Carpendale, Bibok & Liebermann-Finestone, 2012). Therefore, the relationship between the development of social competence and socio-cognitive skills is likely bi-directional, with these abilities reciprocally influencing one another throughout the course of a child’s development (Hughes & Leekam, 2004).

Executive functioning.

One skill area that has shown to be associated with children's social competence is the domain of executive functioning (EF): encompassing the higher order cognitive processes that are particularly important in controlling, monitoring and regulating thoughts, behaviour, and emotions (Carlson, Zelazo, & Faja, 2013; Thorell & Catale, 2014). One model of executive functioning proposed by Miyake and colleagues conceptualizes EF (in adults specifically) as both a unitary construct, and a set of skills that can be broken down into three main components (Miyake et al., 2000). These three components are working memory: the ability to both hold and update information in one's mind, and simultaneously use and manipulate it in different ways, (Garon, Bryson, & Smith, 2008), cognitive flexibility or shifting: the ability to shift one's mindset or view in response to changing environmental or task demands, (Deák & Narasimham, 2003), and inhibitory control: the ability to inhibit a natural or automatic response and instead respond in a purposeful way, (Lee, Bull, & Ho, 2013). When considering executive functioning abilities in young children specifically, there is some uncertainty in the literature regarding how EF may change over the course of development. There is some evidence demonstrating that EF is best described as a unitary construct in young children which develops with a stable trajectory over time (Brocki & Bohlin, 2004; Carlson, 2005; Carlson, Mandell &Williams, 2004a; Wiebe, Espy & Charak, 2008; Wiebe et al., 2011). However, there is also evidence for dissociable components of executive functioning, which have their own developmental trajectories (Carlson, 2005; Carlson & Moses, 2001; Diamond 2002; Huizinga, Dolan, & van der Molen, 2006). One study in particular has suggested that EF in young children can be explained by two distinct components of working memory and inhibition (as opposed to three components) (Müller & Kerns, 2015). Further research examining both sides of the debate has shown that EF may consist of dissociable components that undergo a period of integration in the pre-school years, that then differentiates in later development (Howard, Okely & Ellis, 2015). Due to the variety of evidence demonstrated in the literature, there is no current consensus about the exact nature of executive functioning in young children, and therefore is an area that warrants further exploration.

The prefrontal cortex, one of the most slowly developing areas of the brain, has been found to strongly relate to executive functioning abilities (Benes, 2001; Scheibel & Levin, 1997). Many of the functions of the prefrontal cortex relate to EF abilities, including regulating behaviours, thoughts, and perceptions, in particular by activating or inhibiting other areas of the brain (Knight & Stuss, 2002). Behaviours linked to executive functioning skills have been found to emerge before the age of 2 years old (Carlson, 2005; Reznick, Morrow, Goldman, & Snyder, 2004). Between the age of 3-5 years, executive functioning abilities begin to show considerable development (Carlson, 2005; Garon et al., 2008; Zelazo & Müller, 2002), which continues throughout the lifespan into adulthood.

Executive functioning has been found to be associated with a number of areas important to normal development in children. EF is a significant socio-cognitive skill related to school readiness in young children (Blair & Peters, 2003), as well as success in different areas of academics, including numeracy and literacy in school-aged children (Blair & Razza, 2007). Executive functioning has also been found to show strong ties to the development of social competence in children (Riggs, Jahromi, Razza, Dillworth-Bart & Mueller, 2006), including the development of cooperative social behaviours (Ciairano et al., 2007). EF skills are particularly critical in the navigation of novel situations, including the ability to navigate social situations in various contexts within the environment (Garon et al., 2008). Executive functioning has shown to help facilitate the processing of social information, and therefore is an important component of enacting goal-directed social behaviour (Ciairano et al., 2007). Higher levels of EF in children have been shown to be helpful in achieving personal goals during social exchanges (Ciairano et al., 2007; Priewasser et al., 2013). Research has also shown that deficits in executive functioning in children is significantly associated to negative behaviours towards peers, in both typically developing children (Hughes, White, Sharpen & Dunn, 2000; Raaijmakers et al., 2008; Whalen & Henker, 1992) and atypically developing populations (e.g., those children with 22q11 Deletion Syndrome and fetal alcohol syndrome; Kiley-Brabeck & Sobin, 2006; Schonfeld, Paley, Frankel & O'Connor, 2006). Therefore, there is strong evidence in the literature that executive functioning plays an important role in the development of social competence.

Research has shown that neural areas of the brain (specifically a common frontoparietal network, as well as the anterior insula) related to executive functioning are also activated during competitive tasks (Decety, Jackson, Sommerville, Chaminade & Meltzoff, 2004). Executive functioning has also been linked to the understanding the nature of competitive gameplay, such as how two players in a competitive game situation have mutually exclusive goals (Rakoczy, 2007). Other research has demonstrated that participating in competitive gaming environments (more so than cooperative gaming environments) can in turn lead to increases in executive functioning abilities (Staiano, Abraham & Calvert, 2012). Therefore, it seems that executive functioning skills in children may have important implications in understanding and facilitating effective performance-based behaviours as well as social behaviours in competitive environments.

Theory of mind.

Another key cognitive ability implicated in the development of social competence is theory of mind (ToM): a socio-cognitive skill which allows the attribution of mental states to oneself and others, and specifically enables the understanding that others have mental states different from our own. ToM also helps facilitate the ability to interpret and predict the actions of others, based on their personal motives and goals, which may differ from one’s own (Ashiabi, 2007; Bosacki & Astington, 1999). Early theories conceptualized theory of mind as one singular construct, however more recently in the literature there has been a movement towards understanding ToM as a collection of concepts, which children develop gradually over time (Wellman, 2002). Research has also dissociated diverse aspects of theory of mind that are captured under this broader term, including intuitive versus reflective ToM; decoding versus reasoning abilities; and cognitive versus affective ToM (Hughes, 2011; Kalbe et al., 2010). Regardless of how ToM is defined, it is generally agreed that understanding the thoughts and emotions of others (or possessing theory of mind) is a crucial component in the ability to interact effectively in the social world, and therefore for cognitive and social development of children (Grueneisen, Wyman, & Tomasello, 2015; Hughes & Leekam, 2004; Razza & Blair, 2009; Wellman & Liu, 2004).

Theory of mind typically develops naturally in children over time, through social interactions with parents and peers, through social play, and more specifically through repeated discussions and teaching moments about mental and emotional states (Benson, Sabbagh, Carlson, & Zelazo, 2013; Laranjo, Bernier, Meins, & Carlson, 2010). Theory of mind typically begins to emerge in early childhood, with substantial improvement on ToM tasks being shown between the ages of 3 and 5 years (Perner & Lang, 1999). Different components of theory of mind (including understanding diverse desires, diverse beliefs, and knowledge access) emerge at different stages in development throughout the pre-school years. Understanding the concept of diverse desires captures the skill of knowing that others might have different preferences or desires, even though these desires may be contrary to your own. Understanding diverse beliefs relates to knowing that other people may have different ideas about situations or the world, relative to oneself. Possessing the ToM skill of knowledge access relates to the understanding that while you may have specific information about the world which shapes your own beliefs, other people might not have access to that same information, and therefore their beliefs are shaped on a different perception of the world. Research tends to show that understanding other's desires precedes understanding of other's beliefs, and that understanding both diverse desires and diverse beliefs precedes the understanding of knowledge access (Etel & Yagmurlu, 2015; Rakoczy et al., 2007).

Developing theory of mind abilities in the pre-school years has been shown to have an important impact on the development of children's social competence (Astington & Jenkins, 1995; Walker, 2005; Watson, Nixon, Wilson & Capage, 1999). Research has also shown that theory of mind is not only an important component of social competence during its early development, but throughout later developmental stages as well, including school-age and pre-adolescence (Bosacki & Astington, 1999; Imuta, Henry, Slaughter, Selcuk & Ruffman, 2016; Sidera et al., 2013). In terms of specific behaviours within social contexts, higher levels of ToM in children have been shown to be helpful in achieving personal goals during social exchanges (Ding, Wellman, Wang, Fu & Lee, 2015; Priewasser et al., 2013). Theory of mind abilities in pre-school aged children have been found to facilitate fairness in tasks involving sharing of desirable resources, presumably as children with these abilities are able to take the perspective of others and empathize with their feelings about receiving an unfair amount (Takagishi, Kameshima, Schug, Koizumi, Yamagishi, 2010; Wu & Su, 2014). Conversely, better theory of mind abilities have also been shown to correspond to more competitive behaviours in pre-school aged children. This is due to the fact that having ToM facilitates understanding of deception, deceit, and false beliefs about reality, and the ability to use strategic moves against opponents, or lie to trick another person (Ding et al., 2015; Priewasser et al., 2013; Sher, Koenig & Rustichini, 2014; Sidera et al., 2013). Epley and colleagues (2006) found that encouraging people to take the perspective of a peer (or to use their theory of mind skills) in a competitive environment led to reactive egoism, in that taking the perspectives of one's peers led to the assumption that their peers would behave selfishly during a task in which limited resources were distributed. This reactive egoism therefore led participants to take more than their fair share of resources for themselves, in order to prevent their partner from doing the same. Those who were not prompted to use their theory of mind skills during the competitive task divided the resources more evenly (Epley et al., 2006). Some authors have proposed that competition for scarce resources was one of the driving forces behind the evolution of ToM in the first place, as understanding how your opponents think would give you the upper hand in these early competitive situations (Hare & Tomasello, 2004; Premack & Hauser, 2006). The literature in this area demonstrates that while theory of mind plays an important role in the development of cooperative socially competent behaviours, ToM abilities can also be used to gain advantages over others in competitive situations. The exact nature of how ToM influences children's ability to navigate competitive situations is an area that warrants further investigation.

It is important to note that executive functioning skills, theory of mind abilities, as well as verbal skills are interrelated. Levels of executive functioning and theory of mind abilities have been found to be significantly related both concurrently and longitudinally as children develop (Carlson et al., 2004a; Hughes, 1998; Müller, Liebermann-Finestone, Carpendale, Hammond & Bibok, 2012; Nilsen & Graham, 2009). Inhibitory control abilities in particular have been found to relate to ToM abilities in pre-school aged children (Carlson & Moses, 2001; Carlson, Moses & Claxton, 2004b). Furthermore, young children with more advanced EF skills are better able to hold multiple perspectives in mind at once (drawing on working memory abilities), which is a key component of ToM, and switch more flexibly between perspectives (demonstrating cognitive flexibility; Diamond, 2006). Verbal skills have also been shown to have significant relations to executive functioning and theory of mind (Bosacki & Astington, 1999; Bosacki, 2000; Carlson & Moses, 2001; Jacque & Zelazo, 2005). Thus, when examining associations between each of these skills and social competence, it is important to consider, and potentially control for, the influence of other skill areas.

Future Directions

While the importance of EF and ToM for collaborative socially competent behaviours has been demonstrated in a multitude of research (Ciairano et al., 2007; Green & Rechis, 2006; Imuta et al., 2016; Sidera et al., 2013), the ability to navigate competitive contexts in young children and the necessary corresponding socio-cognitive skills has received less attention. Research to date that has examined the links between EF and ToM in competitive contexts has only established a more basic understanding of how these socio-cognitive skills relate to understanding the nature of competitive gameplay (Heckhausen, 1984; Rakoczy, 2007; Stipek, Recchia, McClintic & Lewis, 1992), or how higher ToM abilities can make children better able to use deception and strategic moves (Priewasser et al., 2013; Sidera et al., 2013). However, more research is needed to investigate the exact role that executive functioning and theory of mind skills play in the ability to simultaneously achieve the dual goals in competitive contexts: performing well and maintaining social relationships with opponents. Furthermore, the strong relationship between EF and ToM is important to consider when investigating how these skills support the development of social and competitive behaviour, as many previous studies only investigate one factor without controlling for the other.

In terms of how children respond to competitive gameplay situations in general, previous research has largely investigated how children respond to the social aspects of competitive gameplay, in which they interact with and can be provoked by negative statements from a peer or opponent (Huyder & Nilsen, 2012; Valcke, 2017; Underwood et al., 1999). Previous research has also investigated how children with behavioural issues respond socially to competitors after failure or success during competitive gameplay (Hughes et al., 2001; Ohan & Johnston, 2007). However, less is currently known about how typically developing pre-school aged children respond both performance-wise and socially to merely winning or losing a competitive game, when social interactions from their competitors are controlled for. No current research has focused on the dual aspects of maintaining social relationships in a competitive context, while still striving to perform well.

Introduction

Learning to navigate the diverse environments within their social world is a crucial aspect of children's development. In becoming socially competent, children are required to adapt their behaviours in relation to the different social contexts they encounter. Social competence can be defined as the ability to use behavioural, cognitive, and affective skills to flexibly adapt to various social situations and norms, based on the environmental context (Bierman & Welsh, 2000). Children's ability to display social competence is crucial to their normative development, as it affects many important areas of functioning, including school readiness and academic performance (Ashiabi, 2007; Denham, 2006; Wentzel & Asher, 1995). Further, longitudinal evidence suggests that poor social adjustment in childhood can result in difficulties later in life, such as dropping out of school, criminal behaviours, and mental health difficulties including both externalizing and internalizing problems (Hymel et al., 1990; Parker & Asher, 1987). Social competence and prosocial behaviour, which can be defined as actions or behaviours which benefit other people, or promote positive relationships with others (Hay, 1994), are linked in many ways. However, prosocial actions are not always the most appropriate behaviours depending on the context, due to the diversity of expectations and demands in various social situations. A challenge that children face in social contexts is that they are simultaneously trying to meet their own individual needs, while also maintaining positive relationships with others. This is particularly salient within competitive contexts in which the participating individuals have divergent self-interests or personal goals. The present work examined children's performative and social behaviour within competitive contexts as well as associations between these behaviours, gender, and socio-cognitive skills.

Beginning in infancy, children show sensitivity to variations in their social environments (Elkins, 2016; Markova & Legerstee, 2006), though their ability to engage effectively within various contexts shows improvement throughout the preschool and school age years, and may progress in concert with the development of other socio-cognitive skills (Ciairano et al., 2007; Wellman & Liu, 2004). Around the age of three, children begin to demonstrate understanding of competitive games, including the understanding of rules and the concept of winning versus losing (Heckhausen, 1984; Stipek et al., 1992). However, at the age of three, while children may understand that their opponent is trying to win the game, they struggle to fully understand the notion that their opponent's goal is directly in opposition to their own personal goals, or to fully understand their opponent's desires in relation to their own (Perner & Roessler, 2010; Preiwasser et al., 2013). Children continue to develop a better understanding of the nuances of competitive contexts as they age. By the age of five, most children are able understand the nuances of competitive situations and adjust their behaviour accordingly (Schmidt et al., 2016).

In competitive contexts, behaving in a socially competent way would include striving to achieve one's personal goals, which are by nature directly opposing the goals of one's social partner (Green & Rechis, 2006). Both opponents are working individually to try to win or succeed at the task (therefore having directly opposing goals), while also following a pre-determined set of social rules and trying to maintain the relationship (Johnson et al., 1981). Learning the skills of negotiation and effective conflict management strategies, or the ability to balance pro-social versus competitive behaviours, are essential to the development of social competence (Rose-Krasnor, 1997). Socially competent children are better able to learn highly successful strategies for entering peer groups and negotiating access to limited resources in competitive environments (Green & Rechis, 2006).

Many factors have been shown to affect children's behaviour in competitive contexts, including age, gender, group size, familiarity with peers and opponents, and resource scarcity (Benenson et al., 2001; Green et al., 2003). One aspect that has been shown to relate to children's behaviour within competitive contexts is their own sensitivity and reactions to success versus failure. For instance, for typically developing children, winning competitive games can lead to intrinsically motivated pro-social behaviours involving helping others, whereas losing does not have the same effects on future behaviour (Isen et al., 1973). Further, studies involving children with behavioural issues have demonstrated that both winning and losing during competitive games can lead to an increase in antisocial behaviours, such as angry or aggressive interactions with peers (Donzella et al., 2000; Hughes et al., 2001; Ohan & Johnston, 2007). While the literature in this area demonstrates that children's behaviour in competitive environments can be influenced by the outcome of the game when considering certain individual differences (such as behavioural issues), there is currently very limited research on how typically developing children generally respond to success versus failure within competitive games.

Research has also investigated how gender can play a role in young children's navigation of competitive environments. The evidence suggests that in general, young girls seem to gravitate towards playing in a cooperative nature in smaller groups, whereas boys tend to gravitate towards playing in larger groups with games of a more competitive nature (Fabes et al., 2004; Jacklin & Maccoby, 1978; Maccoby, 1999). These preferences seem to become particularly salient when children are playing with same-gendered peers, for both boys and girls. These findings suggest that boys therefore gain higher levels of exposure to competitive environments, due to preferences for types of play from a young age (Fabes et al., 2004; Weinberger & Stein, 2008). Research has also demonstrated that for athletic competition specifically, girls do not perform as well in these types of environments (and in particular mixed-gender competitive contexts) compared to boys, even when ability is consistent across genders (Gneezy & Rustichini, 2004; Weisfeld et al., 1982). Other research investigating attributions of success versus failure on school-related tasks suggests that boys tend to attribute personal failures to unstable or environmental attributions that were not their fault, whereas girls tend to provide stable or personal attributions for failure and unstable attributions for success. It followed that children (mostly boys) who provided unstable attributions for failure were more likely to endorse interest in engaging in the tasks again in the future, compared to those (mostly girls) who provided stable attributions for failure (Nelson & Cooper, 1997; Stipek & Gralinski, 1991). Taken together, the literature on gender in competitive contexts suggests that girls may be more heavily impacted by failure in competitive performance-based tasks. However, children's actual performance outcomes in relation to success and failure in competitive contexts has been mainly examined in the context of physical games or athletic activities. Further research is needed as to whether such gender differences would be found in other competitive environments, such as academic contexts or non-physical gameplay situations.

Possessing the necessary socio-cognitive skills is a crucial factor in the development of social competence (Devine et al., 2016; Razza & Blair, 2009). In turn, social interactions also help facilitate further development of socio-cognitive skills (Carlson, 2009; Hammond et al., 2012). Therefore, the relationship between the development of social competence and socio-cognitive skills is likely bi-directional, with these abilities influencing one another throughout the course of a child's development (Hughes & Leekam, 2004).

One skill associated with children's development of social competence is the domain of executive functioning (EF). EF encompasses the higher order cognitive processes that are crucial in controlling, monitoring and regulating thoughts, behaviour, and emotions (Carlson et al., 2013; Thorell & Catale, 2014). Executive functioning can be conceptualized both a unitary construct, and a set of skills that can be broken down into three components (Miyake et al., 2000): working memory (the ability to hold in mind and update information, and simultaneously use and manipulate it; Garon et al., 2008), cognitive flexibility or shifting (the ability to shift one's mindset in response to changing environmental or task demands; Deák & Narasimham, 2003), and inhibitory control (the ability to inhibit an automatic response and instead respond in a purposeful way; Lee et al., 2013). In pre-school aged children specifically, there is evidence to support both the notion of EF as a unitary construct (Brocki & Bohlin, 2004; Carlson, 2005; Carlson et al., 2004a; Wiebe et al., 2008; Wiebe et al., 2011), as well as the notion that EF is a skill set containing dissociable components (Carlson, 2005; Carlson & Moses, 2001; Diamond 2002; Huizinga et al., 2006). Other researchers suggest that EF may consist of dissociable components that undergo a period of integration in the pre-school years, that differentiates in later development (Howard et al., 2015). Children's executive functioning skills start to emerge before the age of 2 years old (Carlson, 2005; Reznick et al., 2004), and between the age of 3-5 years, EF abilities show considerable development (Carlson, 2005; Garon, et al., 2008; Zelazo & Müller, 2002).

Children's EF skills are associated with a number of areas of functioning, including a wide variety of aspects governing the development of social behaviours (Ciairano et al., 2007; Garon et al., 2008; Riggs et al., 2006). Research has also shown that deficits in executive functioning in children are significantly associated with antisocial behaviours (Hughes et al., 2000; Whalen & Henker, 1992). In competitive environments, executive functioning abilities have been found to link to both understanding of the context as well as performance (Rakoczy, 2007; Staiano et al., 2012). While past work has demonstrated the necessity for executive functioning abilities in general social situations, no work to date has specifically investigated the role that EF may play in young children's ability to successfully navigate both performative and social challenges within competitive environments.

Another necessary socio-cognitive skill implicated in the development of social competence is theory of mind (ToM). ToM can be defined as an ability which enables the understanding that others have mental states different from oneself (Wellman & Liu, 2004).

ToM abilities also help to interpret and predict the actions of others, based on their personal motives and goals (Ashiabi, 2007; Bosacki & Astington, 1999). Understanding the thoughts and emotions of others (or possessing theory of mind) is necessary to interact effectively with peers, and therefore for cognitive and social development (Grueneisen et al., 2015; Hughes & Leekam, 2004; Razza & Blair, 2009; Wellman & Liu, 2004). Theory of mind typically begins to emerge in early childhood, with substantial improvement on ToM tasks being shown between the ages of 3 and 5 years (Perner & Lang, 1999). Theory of mind abilities have a substantial impact on the development of children's social competence, throughout early childhood and continuing into adolescence (Astington & Jenkins, 1995; Bosacki & Astington, 1999; Imuta, et al., 2016; Sidera et al., 2013; Walker, 2005; Watson, et al., 1999). While better theory of mind abilities have been shown to facilitate more cooperative or pro-social behaviours (Takagishi, et al., 2010; Wu & Su, 2014), they have also been linked to competitive behaviours, such as using deception or strategic moves to trick competitors (Ding et al., 2015; Priewasser, et al., 2013; Sher et al., 2014; Sidera et al., 2013). Therefore, previous research in this area shows that while theory of mind plays an important role in the development of cooperative socially competent behaviours, ToM abilities can also be used to gain advantages over others in competitive situations. The exact nature of how ToM influences children's behaviour within competitive situations is an area that requires further research.

When considering the importance of socio-cognitive skills, it is important to note that executive functioning skills and theory of mind abilities are interrelated. Levels of executive functioning and theory of mind abilities are significantly related both concurrently and longitudinally in children (Carlson et al., 2004b; Hughes, 1998; Müller et al., 2012; Nilsen & Graham, 2009). Specifically, young children with better EF skills are better able to hold multiple perspectives in mind (drawing on working memory abilities): a key component of

ToM, and switch more flexibly between perspectives (demonstrating cognitive flexibility; Diamond, 2006). Therefore, when examining associations between these socio-cognitive skills and social competence, it is important to consider, and potentially control for, the influence of other skills.

The overall purpose of the current study was to address gaps in the literature by examining the roles that gender and socio-cognitive skills played in competitive contexts. The first aim was to specifically investigate how individual differences (i.e., gender, executive functioning, theory of mind abilities), as well as context or outcomes in the competitive game (i.e., winning, tying, or losing previously) impacted children's subsequent gameplay *performance*. The second aim was to address how these individual factors and gameplay outcomes impacted children's *social behaviours* during the game. These aims were achieved by observing pre-school aged children (4- to 6-year-olds) during a competitive game on an electronic tablet against a fictional peer, who they believed was real child. During the nine trials of the competitive game, the outcome or context was altered so that all participants would win, tie, or lose an equal number of games (i.e., three per condition). After receiving feedback on how they "performed" in each game, children were given the opportunity to record messages for their opponents. It was anticipated that children's actual performance on the task, as well as the pro-sociality content of their messages to opponents, would differ based on the feedback they received about their performance, as well as their gender and socio-cognitive skills. The third aim of this study was to determine how social behaviours during the competitive task related to parent-reported levels of social skills and executive functioning abilities.

In addressing the first aim: investigating factors affecting performance, it was predicted that context would play a role for all children, in that 1) *context (i.e., winning, tying, or losing) will influence performance in the competitive task, in that children would generally* *perform better after feedback that they were winning, but that gender may impact how context affected performance outcomes*. Specifically, if the results demonstrated that girls generally had lower performance outcomes compared to boys, particularly in a losing context, it may suggest that girls may not be as comfortable in competitive environments, which has been demonstrated in previous literature (albeit in a physical game context). It was further predicted that socio-cognitive skills would influence performance but that this may vary based on context, specifically that, 2) *children with better executive functioning skills would have better performance on the task, especially after receiving feedback that they were losing*.

In addressing the second aim of the study: investigating factors affecting social behaviour, it was predicted that 3) *context will influence pro-social behaviours during the task, in that children would generally be more pro-social when winning and less pro-social when losing, but that gender may play a further role in social behaviour outcomes.* This was suspected as it may be easier for children to be more intrinsically pro-social towards others after a personally favourable outcome. In regards to gender, if the results demonstrated that girls generally had lower prosocial behaviours than boys during the competitive game, it may suggest that girls have a more negative reaction to competitive environments compared to boys. It was also predicted that socio-cognitive skills would influence children's social behaviours, in that 4) *children with better executive functioning and theory of mind abilities would generally produce more pro-social messages to partners.* Additionally, it was predicted that socio-cognitive skills may interact with context, in that 5) *context will influence the degree to which executive functioning and theory of mind skills relate to behaviour. Specifically, in a winning condition all children will produce more prosocial responses, but in a losing context only those children with better executive functioning and theory of mind* *abilities will show regulation in their social behaviour (e.g., continue to produce prosocial messages)*.

To address the third aim of this research, which was to investigate how parent-reported skills related to in-lab social behaviours, it was predicted that 6) *higher parent-reported social skills and executive functioning abilities will relate to more pro-social behaviours across contexts.*

Method

Participants

Participating children aged four to six years were recruited from a laboratory database, as well as local elementary schools in a medium sized Canadian city (*N* = 103, M_{age} = 65.26 months; *SD* = 10.78 months; 47 girls). Participants who had a diagnosis of a neurodevelopmental disorder (i.e., Autism Spectrum Disorder) were not included in the analyses (*n* = 1). Therefore, altogether 102 participants were included in the final analyses (M_{age} = 65.15 months; *SD* = 10.78 months; 47 girls). Patterns of development across the age range of participants were examined in three age groups: 4-year-olds (*n* = 35; M_{age} = 55.40 months; *SD* = 8.00 months, 17 girls), 5-year-olds (*n* = 33; M_{age} = 66.68 months; *SD* = 4.92 months, 23 girls), and 6-year-olds (*n* = 34; M_{age} = 76.74 months; *SD* = 5.01 months, 17 girls).

In the final sample, almost all participants spoke English as their first language (*n* = 97). The majority of participants spoke only English (*n* = 79), while the rest of the sample also spoke additional languages at home (*n* = 22). Other languages spoken by participants included Bilen, French, Greek, Polish, Portuguese, Mandarin, Serbian, Sinhalese, and Yoruba. The majority of participants had siblings (one sibling: *n* = 59; two siblings: *n* = 33; three siblings: *n* = 5), while a small amount were only children (*n* = 5). Parental education level of a university degree or higher was reported for more than half of parents (*n* = 123).

Procedure

Eligible participants were contacted through a laboratory database and invited to participate in the lab (*n* = 24) or contacted through interested elementary schools in the area by distributing information letters to the kindergarten and grade 1 classrooms (*n* = 79). Consent forms were signed by parents or guardians before participation, and verbal assent was obtained from each interested participant. Children were tested individually in a quiet room (i.e., either within their school or within the research lab), in one session that lasted 30 to 45 minutes. The tasks were administered in a predetermined order, starting with the vocabulary task, followed by the executive functioning tasks, the theory of mind battery, and finally the competitive game task.

Vocabulary, executive functioning and theory of mind tasks.

Expressive vocabulary task. To assess participant's vocabulary abilities, children first completed the expressive vocabulary subtest of the Wechsler Individual Achievement Test, 3rd edition (WIAT-III; Wechsler, 2009). In this task, children were asked to say the word that best corresponded to a visually presented picture on stimulus cards, and matched a definition read aloud by the researcher. The task was discontinued after four consecutive incorrect responses. An expressive vocabulary score was calculated based on the correct number of items stated, ranging from 0 to 17.

Executive functioning: cognitive flexibility task. Participants then completed a task of cognitive flexibility: the Object Classification Task for Children, developed for use with children aged 3- to 7-years (OCTC; Smidts, Jacobs, & Anderson, 2004). During this task, children completed a practice trial where they paired two sets of identical toys, after being prompted by the researcher that "toys that are the same go together". After completing the practice trial, they sorted six toys (a small yellow airplane, a small red airplane, a small yellow car, a large red airplane, a large red car, and a large yellow car) into groups (free generation condition). More specifically, they were asked to sort the toys into two groups (of three toys each), with something being the same about all the toys in each group. Then they were asked to verbally label the groups they had created. Toys could be correctly sorted by colour, size, and type. For the second and third trials, they were then asked to sort the toys into new groups, where something else was the same about the toys in each group. If children could not complete all three trials, the researcher sorted the toys into the groups that the child had missed and asked the children to label the groups (identification condition). Finally, if the participant was unable to label the groups in the identification condition, the researcher asked them to sort the toys in a specific way that they had previously missed (explicit cuing condition). If participants could not correctly sort any of the toys in the initial free generation condition, the task was completed with only four toys instead of six (a small red car, a small yellow car, a large red car, a large yellow car). Participants were awarded scores combining answers from all conditions: in the free generation condition they were given three points for each correctly sorted group and one point for each correctly named group, in the identification condition (if full points were not awarded in the previous condition) they were given two points for any correctly labelled group, and in the explicit cuing condition (if full points were not awarded in the previous two conditions) they were given one point for any correctly sorted group. The total scores for this task ranged from 0 to 12.

Executive functioning: working memory task. Participants then completed a task measuring working memory: the digit span task from the Wechsler Intelligence Scale for Children, 5th edition (WISC-V; Wechsler, 2014). This task consisted of two sections. In the digit span forwards section, the children repeated sequences of digits read out loud by the researcher. In the digit span backwards section, the participants repeated strings of digits read out loud to them in the reverse order. Each item increased in difficulty as the strings of digits became longer. Each section was discontinued after two consecutive scores of zero within the same item. One point was awarded for each correctly stated string of digits. A digit span total score was calculated by summing the scores from both the digit span forwards and backwards sections, ranging from 0 to 32.

Executive functioning: inhibitory control task. The final executive functioning task measuring inhibitory control was part of the inhibition task from A Developmental Neuropsychological Assessment, 2nd edition (NEPSY-II; Korkman, Kirk & Kemp, 2007). In this task, children labelled a page of visually presented stimuli (rows of arrows) over two conditions, the naming and inhibition conditions. The researcher first provided a practice page (i.e., a single row of arrows) and demonstration (e.g., informing children that arrows pointing up would be labelled as “up”). Then, the researcher gave instructions and demonstrations on how to label the arrows for the inhibition condition (e.g., that when there is an arrow pointing up the correct label would be “down”). After successfully completing the practice section, participants completed the naming condition, where they labelled 40 arrows on a stimulus sheet. Then, they completed the inhibition condition, labelling the 40 arrows on the same sheet, in the opposite way. Both conditions were timed. The scores for correct, incorrect and self-corrected items, and total errors were recorded for both conditions. However, the score used to reflect the participant’s inhibitory control was based on the standardized residuals from regressing the total correct score of the inhibition condition on the total correct score of the naming condition.

Theory of mind battery. Participants then completed Wellman and Liu’s battery of Theory of Mind tasks, which contains five brief ToM tasks (Wellman & Liu, 2004). Each task was designed to assess one aspect of ToM, namely the understanding of: Diverse Desires (understanding that two people may have different desires or preferences), Diverse Beliefs (understanding that others may have different beliefs about a situation), Knowledge Access (understanding that others may have different knowledge about a situation), Contents False Belief (understanding that a person may have a belief that differs from reality), and Hidden Emotions (understanding that a person may display emotions that differ from their internal state).

Each task was comprised of a story about one or more characters, presented to the child using pictures on paper or with small toys. After the participant heard the story, they were asked to answer key questions investigating their ability to represent the mind of particular characters (either one or two questions per task). Scores ranged from 0 to 1 on the

Diverse Desires, Diverse Beliefs, and Knowledge Access tasks and 0-2 on the Contents False Belief and Hidden Emotion tasks. The total ToM battery scores ranged from 0 to 7.

Parent-report questionnaires.

Parents or guardians of participants were asked to fill out two questionnaires regarding their children's socio-cognitive skills.

Social skills. To provide an index of their children's social behaviour, parents completed the Social Skills Improvement System rating scales (SSIS; Gresham & Elliott, 2008). Parents were asked to indicate how often their child exhibited behaviours such as taking turns with peers, on a four-point scale ranging from never to always. While the original version of the SSIS is composed of 79 items, only items measuring social skills (and not problem behaviours) were included, resulting in 44 included items. This abbreviated version of the SSIS allowed the calculation of seven subscale scores (measuring Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, Self-Control), and a total Social Skills score. The SSIS shows high internal consistency estimates, and moderately high validity indices for the social skills scale (Gresham, Elliott, Vance, & Cook, 2011). The total social skills score was used to assess participant's social skills as rated by their parents in this study. The internal consistency of the SSIS for this sample was $\alpha = .95$.

Executive functioning. To assess children's demonstration of executive functioning in their everyday settings, parents completed the Childhood Executive Function Inventory (CHEXI; Thorell & Nyberg, 2008). The CHEXI demonstrates adequate test–retest reliability, and good diagnostic validity for measuring EF in children (Thorell & Nyberg, 2008). While the original CHEXI contains 24 items, only items that fell on the working memory and inhibition subscales were used, resulting in 15 items. This abbreviated version of the CHEXI allowed the calculation of two subscale scores (working memory and inhibition), and a total executive functioning score. The total EF score was used to assess participant's executive functioning abilities as rated by their parents in this study. The internal consistency of the CHEXI for this sample was $\alpha = .90$.

Competitive game task.

To assess children's social and performative behaviour within a competitive context, they played a competitive game task wherein they experienced three conditions (winning, tying, and losing). Each condition was comprised of three consecutive trials so that the effects of game outcome on behaviour over time could be investigated, yielding in a 3 (condition) X 3 (trial) design.

The researcher first instructed the children how to play the games using a tablet. The children were shown a practice screen and told to tap the screen on all the target objects (e.g., sea creatures) but not the non-target objects (miscellaneous other objects; Figure 1a). As the child tapped the target objects, they would disappear from the screen. Following this practice, the researcher informed the children they would be playing a series of similar games against other children (of same age/gender) who were playing in a different location. They were informed that the goal was to collect as many target objects as they could, but that the other player would be also trying to do the same thing. However, unbeknownst to the participants, the other "players" were actually virtual players programmed into the tablet. The participants were then told that after each game, they would send a message to their opponent, as the tablet could record their voice and turn it into a message on the screen. They were also told that the other players would send a message back to them, and that all of the messages they received would be read after the last game. Participants were finally told that they might get to meet the other players in a common area after all of the games were finished. This aspect was communicated to participants in order to increase motivation to maintain relationships with their opponents, a method which has been used previously in similar studies (Ohan & Johnston, 2007).

Participants then completed the nine trials (i.e., in sets of three within each condition). Before each gameplay condition, there was an introduction screen where the (virtual) opponent was introduced (Figure 1b). For each of the three trials within the specific condition (i.e., win, tie, lose) the participant played against the same opponent. The introduction screen also displayed the target objects to be collected for that condition (fruit, animals, or clothing) and was shown again before each trial. The order of the conditions, names of the opponents in each condition, and target objects to collect in each condition were counterbalanced across the participants.

After pressing the start button, participants saw a screen containing a 12 x 16 grid of target and non-target objects (Figure 1c). Each trial lasted 20 seconds, in which the participant aimed to collect as many target objects as possible. To create the different conditions, the task was programmed to also have random target objects disappear during the gameplay, signalling that the opponent had collected those objects first. Specifically, in the winning condition, for every two target objects the participant collected, one randomly selected target object disappeared from the screen after a short delay, giving the illusion that their opponent had collected it. For the tying condition, for every one object that participants collected, one other random object disappeared from the screen. For the losing condition, for every one object the participant collected, two other random objects disappeared.

Immediately following each trial, a feedback screen was displayed, which provided the results of the game (i.e., consistent with the condition) using a simple bar graph (Figure 1d). For instance, if a child was in the winning condition, the bar above their name would be higher than the opponent’s bar, and would also have a star on it. The researcher also provided feedback to the child, letting them know if they had won, lost, or tied that specific game.

After the feedback screen, a message screen was displayed (Figure 1e). This screen displayed the statement "[opponent's name] is sending you a message!", and three moving dots indicating that the opponent was recording a message. The participant was then prompted by the researcher to record their own message to their opponent ("now it is time to send [opponent's name] a message, what would you like to say?"), with the tablet audio recording their voice. If participants responded, "I don't know" or did not respond after a period of 15 seconds, the researcher prompted the participant a second time by stating "you can say anything you want." If the participant responded a second time that they did not know what to say or refused to answer, the recording was completed (with participant's non-answers noted) and proceeded to the next trial. The game, feedback, and message procedures were then repeated.

After all test trials were completed, the participants played a final "feel-good" trial where they won (i.e., so all participants finished the task on a successful note). However, no data was collected from this trial. The researcher then read/showed them a screen of written messages presumably from their opponents (Figure 1f). All messages contained positive content (e.g., "Wow, there are so many things to collect", "Good game!"). Participants were then debriefed about the virtual nature of their opponents and provided with the opportunity to ask questions.

The two main measures within this task were: 1) the participant's actual performance on the task (i.e., the number of target objects collected, subtracting the number of the non-target objects tapped), and 2) the pro-sociality of the messages sent to opponents.

The pro-sociality of each message sent by participants was coded by two research assistants who knew the context (i.e., condition) of each message, as they could only fully interpret the content of each message by knowing the situational context. However, the coders were blind to any demographic information about the participants, such as gender or age. The coders rated each statement on a seven-point Likert scale ranging from -3 (very antisocial) to +3 (very prosocial). Inter-rater reliability between coders was calculated by intraclass correlations, *ICC* = .90. More prosocial statements constituted messages that would improve the relationship between the participant and opponent, such as genuine praise of the opponent (e.g., “you are so good at this!”) or polite statements (e.g., "thanks for playing”). In contrast, statements towards the antisocial end of the scale constituted messages that would be a detriment to the relationship, such as criticism of the opponent (e.g., “you are terrible at playing”), or bragging about oneself (e.g., “I won again because I’m the best”).

Results

Preliminary Analyses

The data were first analysed for outliers. No outliers were detected on the parental questionnaires measuring social skills and executive functioning. Three outliers (+/- 3 SD) were revealed for the in-lab tasks [expressive vocabulary task (*n* = 1); object classification task (*n* = 1), standardized residuals of the inhibition measure (*n* = 1)]. These three outliers were then Winsorized to reduce the extremity of the scores.

Missing in-lab task data were as follows: [object classification task (*n* = 1), digit span task (*n* = 1), standardized residuals of the inhibition measure (*n* = 4), , competitive task performance outcomes (*n* = 5)]. Missing data on in-lab tasks was either due to refusal to complete the task (for the OCT, digit span, and inhibition tasks), or due to program error on the electronic tablet (competitive task performance outcomes). Missing data for questionnaire measures were as follows: [demographic questionnaire (*n* = 1), SSIS (*n* = 5), CHEXI (*n* = 4)]. Missing items on the SSIS and CHEXI parental-report questionnaires (5.76% of items missing for answered questionnaires) were analyzed using the Little MCAR test to determine whether they were left blank at random, with both questionnaires revealing no significant results (p = .842). The missing items were then imputed in SPSS by multiple imputation, with the variables being all answered items within that questionnaire for that particular participant.

Analyses of skew and kurtosis for the in-lab tasks and parental questionnaires revealed no significant results (ps > .11).

Descriptive statistics of children's performance on the session tasks and parental questionnaires are included in Table 1.

As the three conditions were counterbalanced across all participants, order effects were investigated using two 6 (Order) x 3 (Condition) x 3 (Trial) mixed ANOVA analyses, with the dependent variables being gameplay performance and message pro-sociality. Results investigating performance revealed no significant main effect of order (p = .908) or interaction effects involving order (ps > .183). Results investigating pro-sociality also revealed no significant main effect of order (p = .126) nor interaction effects involving order (ps > .318).

Bivariate correlations between measures of expressive vocabulary, executive functioning, theory of mind, social skills, age, and gender are shown in Table 2. Scores on all in-lab tasks, but not on parental questionnaires, were shown to improve significantly with age. There were no significant correlations between gender and performance on any of the socio-cognitive tasks or questionnaire scores. Children's performance on in-lab tasks (i.e., measures of vocabulary, ToM and EF) were all significantly correlated, consistent with past work showing associations between these measures (Bosacki, 2000; Carlson et al., 2004a; Jacque & Zelazo, 2005; Müller et al., 2012). As all in-lab measures of executive functioning were significantly correlated at the p > .01 level, a composite measure of EF was created so as to reduce the number of predictors, by calculating an average score of the standardized scores from the three EF tasks.

Below, results of statistical analyses are organized by dependent variable. First, children's performance on the game will be presented and then analyzed in relation to gender, condition, trial, ToM and EF. Second, analyses examining the dependent variable of pro-sociality will be presented and then examined in relation to gender, condition, trial, ToM, and EF. Third, relations between parental- report measures of EF and social skills are examined in relation to the pro-sociality of children's messages.

Gameplay Performance

Participant's actual scores during gameplay (i.e., number of correct target objects they tapped subtracting the number of incorrect non-target objects tapped) were recorded and analysed to address the effect of condition, trial and gender on performance, and next the associations with ToM and EF were examined.

Effects of condition, trial and gender on performance.

A 2 (Gender) x 3 (Condition) x 3 (Trial) mixed ANOVA was used to investigate if children's actual gameplay performance depended on whether they believed themselves to be winning, tying, or losing (i.e., by condition), and whether their gameplay performance differed over time (i.e., by trial).

The analyses revealed a significant main effect of Gender, $F(1, 95) = 5.72$, $p = .019$, $\eta p^2 = .06$, on children's performance. Namely, girls ($M = 14.60$, $SE = .89$) were shown to perform significantly better than boys ($M = 11.71$, $SE = .82$) on the competitive task. No significant interactions with Condition or Trial related to Gender were found (*p*s > .67).

As Mauchly's Test of Sphericity was significant for Trial ($p = .006$) and Condition* Trial ($p < .001$), values from the Huynh-Feldt corrections are reported. The analyses revealed significant main effects of Condition, $F(2, 190) = 41.78$, $p < .001$, $\eta p^2 = .31$, and Trial, $F(1.87, 177.48) = 5.84$, $p = .004$, $\eta p^2 = .06$. However, the main effects of Condition and Trial were qualified by a significant interaction effect between Condition*Trial, $F(308.64, 9357.48) = 3.13$, $p = .019$, $\eta p^2 = .03$. To explore the significant interaction, the trial by trial performance was compared using paired t-tests within each condition (with Bonferroni correction, .05/3). Within the winning condition it was found that there were significant improvements in performance from the 1st trial ($M = 14.17$, $SD = 8.43$) to the 2nd trial ($M = 16.76$, $SD = 7.64$), $t(96) = -4.40$, $p < .001$, as well as improvements in performance from the 1st trial ($M = 14.17$, $SD = 8.43$) to the 3rd trial ($M = 16.39$, $SD = 8.97$), $t(96) = -3.60$, $p = .001$. No significant difference in performance was found between the 2nd and 3rd trials for the winning condition ($p = .390$). In the tying condition, the results again demonstrated that there were significant improvements in performance between the 1st trial ($M = 12.64$, $SD = 6.92$)

and 2nd trial (M = 13.79, SD = 8.88), $t(96) = -2.45$, $p = .016$. Marginal improvements in performance were found between the 1st trial (M = 12.64, SD = 6.92) and 3rd trial (M = 13.85, SD = 8.23), $t(96) = -2.26$, $p = .026$. No significant difference in performance was found between the 2nd and 3rd trials for the tying condition ($p = .924$). In the losing condition, there was no significant difference in performance across any of the trials (ps > .280). These results demonstrate that for the winning and tying conditions, children's gameplay performance improved after receiving "feedback" that they were doing well (or at least as well as their opponents). However, in the losing condition, children's performance showed no difference between trials.[1] See Figure 2.

Relations between executive functioning and theory of mind on performance.

The influence of children's socio-cognitive skills on their gameplay performance was examined for the winning and losing conditions separately using two linear regression analyses. In the regressions, two dependent variables were used to examine performance, 1) total performance score (the sum of gameplay scores from trials 1-3 in each condition), and 2) change performance scores (the gameplay score of the 1st trial subtracted from the score of the 3rd trial, such that a positive score would show improvement over trials).

Age (in months), expressive vocabulary scores, and gender were entered into the regression models in the first step. ToM and EF were entered simultaneously in the second step of the regression model. The interactions between gender and ToM, as well as gender and EF, were investigated by creating interaction variables using mean centred variables, and then entered in the third step of the regression model.

[1] Further comparisons across conditions (by each trial) were not conducted, as the conditions differed in the sense that more items were available to be tapped in the winning condition (and in converse fewer items available in the losing condition) due to the way the game was designed (i.e., with items collected by opponents disappearing at different scheduled rates for each condition). Thus, comparisons in performance by trial *across* the conditions are not meaningful.

Bivariate correlations between independent variables (age, gender, vocabulary, executive functioning, theory of mind, social skills) and dependent variables (total and change performance scores, average and change pro-sociality scores) are presented in Table 3 and Table 4.

Predictors of performance in the winning condition.

Total performance. The regression model (using the DV of total performance) for the winning condition, at step one, was significant, $R^2 = .35$, $F(3, 88) = 15.91$, $p > .001$. Age (in months) ($\beta = .42$, $p > .001$) and Expressive Vocabulary score ($\beta = .22$, $p = .046$) both contributed significantly to the model, showing that older age and better vocabulary scores related to better performance. However, Gender did not contribute significantly to the model ($p = .166$). At step two, introducing ToM and EF resulted in a statistically significant R^2 change in the model, $R^2 = .44$, $\Delta R^2 = .09$, $\Delta F(2,86) = 6.52$, $p = .002$. Examining the regression weights of the predictors, ToM ($\beta = .34$, $p = .001$) was found to be a statistically significant predictor, while EF ($p = .883$) was not significant. In step three, there was no significant R^2 change in the model, $R^2 = .45$, $\Delta R^2 = .02$, $\Delta F(2, 84) = 1.12$, $p = .331$, nor were the interaction variables were found to be significant (ps > .130). These results suggest that, beyond Age and Expressive Vocabulary score, higher ToM ability was associated with improved gameplay performance in the winning condition.

Performance change. The regression model (using the DV of change between the first and third trial) for the winning condition, at step one was not significant, $R^2 = .02$, $F(3, 88) = 0.69$, $p = .562$, and neither were any of the predictors (ps > .159). At step two, introducing the variables of ToM and EF did not result in a statistically significant R^2 change, $R^2 = .06$, $\Delta R^2 = .04$, $\Delta F(2, 86) = 1.65$, $p = .198$, and neither predictor was significant (ps > .151). At step three, the R^2 change in the regression model was found to marginally improve significance, $R^2 = .11$, $\Delta R^2 = .05$, $\Delta F(2, 84) = 2.55$, $p = .084$, (model statistic: $F(7, 84) = 1.53$, $p = .169$)

with the interaction variable of Gender x EF showing statistical significance (β = -.41, p = .034), but not the interaction variable of Gender x ToM (p = .099). That is, in the winning condition, gender was found to have a moderating effect on the relationship between children's EF and change in performance across trials. To interpret this interaction, simple slopes analyses were conducted (Figure 3). With respect to girls, there was a statistically significant relationship between EF and performance change, β = .52, B = 4.04, B SE = 1.76, p = .024, such that girls with better EF skills had a greater improvement in their performance between the first and third trials. In contrast, for boys, this relationship was not significant (p = .953), demonstrating that EF did not affect their change in performance.

Predictors of performance in the losing condition.

Total performance. The regression model (using the DV of total performance) for the losing condition, at step one, was statistically significant, R^2 = .13, F(3, 88) = 4.44, p = .006. Examining the individual variables within the model, Age (in months) (β = .30, p = .015) and Gender (β = -.22, p = .030) both contributed significantly to the regression model, demonstrating that older age related to better total performance, and that girls showed better total performance in the losing condition. Expressive Vocabulary score did not significantly contribute to the model in step one (p = .703). In step two, introducing ToM and EF resulted in a statistically significant R^2 change, R^2 = .19, ΔR^2 = .06, ΔF(2, 86) = 3.14, p = .048. Examining the regression weights of the predictors, ToM (β = .28, p = .015) was found to be a statistically significant predictor, while EF (p = .924) was not. In step three, neither the R^2 change in the model, R^2 = .21, ΔR^2 = .02, ΔF(2, 84) = 0.92, p = .402, nor the interaction variables (ps > .251) were found to be significant. These results suggest that, beyond Age and Gender, higher ToM ability was again associated with better gameplay performance in the losing condition.

Change performance. The regression model (using the DV of change performance) revealed for the losing condition, that the first model was not significant, R^2 = .03, $F(3, 88)$ = 0.03, p = .415, and that the second and third model did not show a significant R^2 change; step 2 R^2 = .04, ΔR^2 = .01, $\Delta F(2, 86)$ = 0.50, p = .608; step 3 R^2 = .07, ΔR^2 = .02, $\Delta F(2, 84)$ = 1.09, p =.341. None of the predictors (ps > .132) or interaction variables (ps > .289) were significant at any step.

Pro-Sociality of Messages

Recall that participants sent messages to their opponents during the task. First the effect of condition, trial and gender on the pro-sociality of message content was examined and next the associations with ToM and EF were examined.

Effects of condition, trial and gender on pro-sociality.

A 2 (Gender) x 3 (Condition) x 3 (Trial) mixed ANOVA was used to investigate if pro-sociality of messages differed whether children believed themselves to be winning, tying, or losing (condition), and whether message pro-sociality differed over time (trial).

The analyses revealed a significant main effect of Condition, $F(2, 200)$ = 4.67, p = .010, ηp^2 = .05, on children's pro-sociality of messages. No other significant main effects were found for Trial (p = .123) or Gender (p = .578). No significant two-way interactions were found (ps > .149). However, there was a significant three-way interaction between Condition, Trial and Gender, $F(4, 400)$ = 3.53, p =.008, ηp^2 = .03.

To explore the significant three-way interaction between Gender, Condition and Trial, the effects of Condition and Trial were analysed separately for boys and girls, using two 3 (Condition) x 3 (Trial) ANOVAs (Figure 4).

Girls. The ANOVA analysis revealed no significant main effects of Condition (p = .641) nor Trial (p = .699) for the pro-social content in girls' responses. However, there was a significant interaction effect between Condition and Trial, $F(4, 184)$ = 2.65 p = .035, ηp^2 =

.05. To further explore this interaction effect, paired sample t-tests were conducted (with Bonferroni correction, .05/3). There were no significant differences in pro-sociality across the trials for the winning condition (*p*s > .55), nor for the tying condition (*p*s > .13). For the losing condition, participants showed a marginally significant decline in pro-sociality between the 1st trial (*M* = 0.64, *SD* = 1.01) and 3rd trial (*M* = 0.30, *SD* = 1.02), $t(46) = 2.43$, $p = .019$. Pro-sociality was also found to decline marginally between the 2nd trial (*M* = 0.53, *SD* = 1.00) and 3rd trial (*M* = 0.30, *SD* = 1.02), $t(46) = 1.83$, $p = .078$. No significant difference was found between the 1st and 2nd trials ($p = .359$). These results suggest that for girls, the winning and tying conditions elicited no differences in pro-sociality over time. However, in the losing condition, girls became less pro-social after receiving feedback that they were losing to their opponent.

Boys. ANOVA analyses revealed significant main effects of Condition, $F(2, 108) = 5.52$, $p = .005$, $\eta p^2 = .09$, and Trial, $F(2, 108) = 3.50$, $p = .034$, $\eta p^2 = .06$, for boys' pro-sociality of their messages. No significant interaction effect of Condition*Trial was found for boys ($p = .141$). To further explore the significant main effects, paired sample t-tests were conducted to analyse the average pro-sociality between the winning, tying and losing conditions, and also between the 1st, 2nd and 3rd trials (across all conditions; with Bonferroni correction, .05/3). For boys, there were no significant differences in pro-sociality between the winning and tying conditions ($p = .213$). A statistically significant difference was found for pro-sociality between the winning and losing conditions, $t(54) = -3.08$, $p = .003$, such that the boys were more pro-social in the losing condition. The difference in pro-sociality between the tying and losing conditions was marginal, $t(54) = -1.94$, $p = .058$, showing again that the boys were more pro-social in the losing condition. When comparing across trials, results showed that there were no significant differences in pro-sociality between the 1st and 2nd trials ($p = .172$) or between the 1st and 3rd trials ($p = .293$) across conditions. There was a significant increase in pro-sociality between the 2nd and 3rd trials across conditions, $t(53) = -2.78$, $p = .007$. These results suggest that boys were the most pro-social in the losing condition (across trials), and also (across conditions) were more pro-social on their final trial when compared to the second trial.

Comparisons across gender. The fully explore the significant 3-way interaction between Gender*Condition*Trial, independent t-tests were used to compare girls' and boys' pro-sociality across each trial by condition (with Bonferroni correction, .05/9). Within the winning and tying conditions, there were no difference between the genders for any of the trials, (*p*s > .332). In the losing condition, the pro-sociality content of messages did not differ between genders at trials 1 and 2 (*p*s > .812), but at trial 3 boys provided significantly more pro-social content within their messages than did girls, $t(99) = -3.35$, $p = .001$.

Relations between executive functioning and theory of mind on pro-sociality.

The influence of children's socio-cognitive skills on the pro-sociality content of their messages for the winning and losing conditions was examined using linear regression analyses. In the regressions, two dependent variables were used to examine performance, 1) average pro-sociality score (the mean of message pro-sociality scores from trials 1-3 by condition), and 2) change pro-sociality scores (the message pro-sociality score of the 1st trial subtracted from the pro-sociality score of the 3rd trial, so that a positive number would indicate more pro-sociality over time). To control for age (in months), expressive vocabulary scores, and gender, these variables were entered into the regression model in the first step. The socio-cognitive skills: ToM and EF, were entered simultaneously as the second step in the regression model. The interactions between gender and ToM, as well as gender and EF, were entered as the third step in the regression model.

Predictors of pro-sociality in the winning condition.

Average pro-sociality score. The regression model (using the DV of average pro-sociality) revealed for the winning condition, at step one, that the regression model was statistically significant, R^2 = .12, F(3, 93) = 4.28, p = .007. When examining the predictor variables, Age (in months) (β = .35, p = .003) contributed significantly to the regression model, such that increasing age was associated with higher pro-sociality, whereas Expressive Vocabulary (p = .963) and Gender (p = .814) did not contribute significantly to the model. At step two, introducing ToM and EF did not result in a statistically significant R^2 change, R^2 = .12, ΔR^2 = .00, ΔF(2, 91) = 0.02, p = .978, and neither of the predictors for the second step were statistically significant (ps > .832). In step three, the R^2 change in the regression model was not found to be statistically significant, R^2 = .16, ΔR^2 = .03, ΔF(2, 89) = 1.78, p = .174, nor was the interaction variable of Gender x ToM significant (p = .280). However, the interaction variable of Gender x EF was found to have marginal significance (β = -.325, p = .065).

Change pro-sociality score. The regression model for winning (using the DV of change in pro-sociality) was not significant at the first step, R^2 = .01, F(3, 93) = 0.35, p = .788, and the R^2 change at the second and third steps were also not significant; step 2 R^2 = .05, ΔR^2 = .04, ΔF(2, 91) = 1.91, p = .154; step 3 R^2 = .05, ΔR^2 = .00, ΔF(2, 89) = 0.15, p = .860. However, adding EF to the model at step 2 demonstrated marginal significance (β = -.29, p = .054). None of the other predictors across any of the steps (ps > .260) or interaction variables in step 3 (ps > .694) were significant.

Predictors of pro-sociality in the losing condition.

Average pro-sociality score. The regression model (using the DV of average pro-sociality) for the losing condition was significant at step one, R^2 = .09, F(3, 93) = 2.97, p = .036. Age (in months) (β = .27, p = .026) contributed significantly to the regression model, such that increasing age again related to higher pro-sociality, and Gender (β = .18, p = .074) showed trending significance, showing that boys were marginally more pro-social than girls. Expressive Vocabulary score (p = .627) did not significantly predict the average pro-sociality in step one. At step two, introducing ToM and EF did not result in a statistically significant R^2 change, R^2 = .10, ΔR^2 = .02, $\Delta F(2, 91)$ = 0.81, p = .449, and neither of the added predictors were statistically significant (ps > .213). At step three, the R^2 change in the regression model was not found to be statistically significant, R^2 = .11, ΔR^2 = .00, $\Delta F(2, 89)$ = 0.11, p = .897, and the interaction variables were not significant (ps > .725).

Change score. The regression model (using the DV of change in pro-sociality) for the losing condition at was statistically significant at step one, R^2 = .12, $F(3, 92)$ = 3.99, p = .010. Gender (β = .32, p = .002) contributed significantly to the model, such that boys became more prosocial over trials compared to girls, but Age (in months) (p = .634) and Expressive Vocabulary score (p = .119) were not significant. At step two, introducing ToM and EF to the model did not result in a statistically significant R^2 change, R^2 = .12, ΔR^2 = .00, $\Delta F(2, 90)$ = 0.02, p = .985, and neither predictor was statistically significant (ps > .869). Similarly, at step three, the R^2 change in the regression model was not found to be statistically significant, R^2 = .14, ΔR^2 = .02, $\Delta F(2, 88)$ = 1.10, p = .338, nor were the interaction variables (ps > .142).

Parent-reported skills on pro-sociality.

To investigate the relationship between parent-reported socio-cognitive skills (social skills and executive functioning) and pro-sociality, bivariate and partial correlations controlling for age (in months) and gender were conducted to examine the relationships between SSIS and CHEXI scores, average pro-sociality scores and change pro-sociality scores by condition (winning, tying, losing). No significant correlations were found (ps > .107). Results are shown in Table 5.

Discussion

The overarching aim of the present study was to explore the degree to which context (i.e., the outcome in terms of winning, tying, or losing) impacts preschool-age children's performative and social behaviours within a competitive game. This aim was addressed by altering the context of a competitive game, ensuring that all children would win, tie, or lose games against their (fictional) peers. Within each outcome condition, both children's performance and the pro-sociality content of their messages sent to opponents was measured. Findings highlight the importance of outcome, gender and socio-cognitive skills for young children's performance in competitive games, as well as the interactions between outcome and gender on children's pro-sociality within competitive environments.

Performance Outcomes

The first aim of the study was to investigate which factors impacted children's game performance in a competitive environment. Across all children, it was found that, consistent with the first hypothesis, participants showed improvements in performance after receiving feedback that they were winning or tying against their opponents, but no improvement was shown after receiving feedback in the losing condition.

While typically developing children's social responses to success and failure during competitive games has been researched previously (Donzella, et al., 2000; Isen et al., 1973), this study is the first of its kind to examine how perceived performance relates to future performance during competitive games in pre-school aged children. Therefore, this study presents novel findings that suggest that receiving feedback that one is doing well (i.e., winning or tying against an opponent) may motivate young children into performing better on subsequent trials, however receiving feedback that one is losing does not result in the same motivation to improve performance. These results may however relate to prior work on children's responses to success versus failure in academic environments. Previous research suggests that children with fixed mindsets tend not to persevere or try harder when faced with failure, and instead respond with frustration or helplessness, as they believe that outcomes are based on personal fixed factors (e.g., intelligence, academic abilities) that cannot be changed (Dweck 2013). Dweck's research applied to this context would suggest that if participants had fixed mindsets, receiving feedback that they were losing would lead them to believe that there was nothing they could do to improve their performance, and therefore they did not try harder on subsequent trials. In comparison, after receiving feedback that they were doing well (i.e., winning or tying), this would further motivate children with fixed mindsets, as it would provide concrete evidence that they already possessed the necessary skills to perform well in the game. The findings from this work regarding how feedback on success and failure in competitive environments may influence future performance may have important implications for social, sporting and academic contexts. As these findings were novel in regard to the current literature, replication will be necessary before real-world implications can be implemented based on these results.

Further factors shown to affect children's performance included both gender and socio-cognitive skills. Significant effects of gender on performance were found, in that girls performed significantly better than boys on the task, but that these effects were not further influenced by perceived outcome of the game. Thus, this finding can be interpreted reflecting girls' higher cognitive skills within this age range, which is consistent with previous findings on gender differences in pre-school aged children's abilities (Raaijmakers et al., 2008; Wiebe, et al., 2008), rather than a response to the specifics of the context (though it should be noted that no gender differences were found in the in-lab EF measures for this study).

It was also predicted that children with better executive functioning skills would demonstrate better performance in the game, especially in a context where they were told they were losing. The results showed significant performance effects related to EF abilities, but only for girls and within a winning context. Specifically, girls with high EF demonstrated substantially improved performance on the task after receiving feedback that they were winning, compared to girls with low EF. Contrary to predictions, associations between EF and performance were not seen in the losing condition. Within the winning condition, the present results fit with similar studies which demonstrate that higher EF abilities relate to better understanding of and performance in competitive environments (Rakoczy, 2007). This work adds to the literature by demonstrating that the outcome (namely, winning as opposed to losing) is also important. Although the exact reasoning behind this finding cannot be confirmed from the data collected here, it is possible that after receiving feedback that they were winning, girls with higher EF had both the ability and contextually-driven motivation to try harder at the task (similar to discussion above regarding motivation after success versus failure). However, girls with low EF may not have had the necessary abilities to substantially improve performance after receiving feedback that they were winning.

It is interesting to note that no effects of EF on gameplay performance were found for boys. It may be the case that boys were exerting maximum effort in the task from the beginning, and therefore there was less room for improvement in their performance after receiving feedback, regardless of their executive functioning abilities. Previous work has shown that in competitive environments, that even when equally matched in abilities, girls tend to show worse performance outcomes than boys (Gneezy & Rustichini, 2004; Weisfeld et al., 1982). This suggests that in some competitive environments, unlike boys, girls may not always be exerting their maximum efforts or achieving their full potential. One possibility for this may be that girls are less likely to self-select or engage in competitive environments at this age compared to boys, so that they have less exposure to these settings in general (Fabes et al., 2004). In the context of this research, it would follow that after receiving good news about their previous performance, that girls with higher EF abilities were able to push themselves further to achieve their full potentials, whereas boys' performance had already reached its ceiling. It would be useful for further research to be conducted on performance based in competitive contexts in relation to gender and EF in pre-school aged children to see if patterns found here replicate. Moreover, it would be interesting to see whether such patterns exist across later developmental stages.

Although no predictions were made on the influence of theory of mind on performance, ToM was found to significantly predict performance across both the winning and losing conditions, even after controlling for age, gender, and vocabulary skills. While theory of mind abilities have been shown in the past to improve performance during competitive games (Ding et al., 2015; Priewasser et al. 2013; Sher et al., 2014; Sidera et al., 2013), these studies specifically demonstrate how ToM can be used to one's advantage when playing against actual opponents. In this study however, the competitors in the game were merely a computer program, and although this was unbeknownst to the participants, having better abilities to understand the mental state of one's opponent would not lead to any advantages in this game. It is possible in this instance that having better theory of mind abilities led to children having a better understanding of competitive games in general (e.g., "The other player is going to try to win, so I should also try hard"), and this link between ToM and understanding has been demonstrated in previous literature (Perner & Roessler, 2010; Schmidt et al., 2016). Therefore, it is possible that simply having a better understanding of competitive games may be the reason why theory of mind abilities led to improvements in performance in this specific study.

Social Behaviour Outcomes

The second aim of this research was to investigate which factors (gender, socio-cognitive skills, context) related to participants' social behaviour. It was predicted that children would generally produce more aggressive messages in a losing context, and more pro-social messages when they were winning, but that this may also be influenced by gender. This prediction was in line with previous work that after winning a rigged competitive game, children behaved more pro-socially towards an unfortunate peer, however after losing the game they did not display the same level of pro-social behaviours towards others (Isen et al., 1973). The results from this study demonstrate support for the hypothesis for girls, but not for boys. For girls, it was shown that after receiving feedback that they had lost to their opponents, the pro-sociality of their messages continuously decreased across trials. However, boys demonstrated higher levels of pro-sociality across the losing condition when compared to their social behaviour in the winning and tying conditions. Furthermore, boys were significantly more pro-social than girls on the final trial of the losing condition.

Past work finds that boys are generally more drawn to competitive games, whereas girls tend to prefer games of a cooperative nature (Jacklin & Maccoby, 1978; Maccoby, 1999). Thus, boys likely have greater exposure to competitive environments, and perhaps are more comfortable or accustomed to losing against their peers (Fabes et al., 2004). In light of the results from this study, it is possible that boys displayed more pro-social behaviours in the losing condition as their greater exposure to competitive contexts has resulted increased learning about how to respond in a pro-social manner in the face of failure. In contrast, girls may not be as acclimated to competing against or losing to their peers and therefore had more difficulty generating pro-social responses. Another possible explanation for the decline in pro-sociality across the losing condition for girls but not boys may be how children make attributions for failure. Previous work has shown that girls tend to make more internal or personal attributions for failure across a variety of contexts, as opposed to boys who generally make more external or environmental attributions for failure (Nelson & Cooper, 1997; Stipek & Gralinski, 1991). Failure during social gameplay contexts has also been shown to have a larger effect on girls compared to boys, in that they subsequently show lower affect and put forth less effort in future interactions (Manolis & Milich, 1993). It is possible that if the female participants in this study made more internal attributions of failure in response to losing, in other words that this perceived failure affected them more greatly, that subsequently their pro-sociality decreased more so than for boys. Future research should endeavour to gain more insight into the reasoning behind children's social responses to opponents during competitive gameplay, and particularly how this relates to gender and context (i.e., when winning versus losing).

This work also investigated associations between children's socio-cognitive skills and their social behaviours during competitive gameplay. It was predicted that children with better theory of mind and executive functioning abilities would produce more pro-social messages to opponents. It was further hypothesized that context would influence the degree to which EF and ToM skills related to social behaviour, in that when winning all children would produce more prosocial responses, but when losing only those children with better EF would show regulation in their social behaviour. While age was related to the pro-sociality of children's messages across all contexts (with older children displaying more pro-social behaviours), neither children's theory of mind nor executive functioning abilities were found to relate to the pro-sociality of their messages. This null effect is somewhat contrary to evidence in the literature that both ToM (Astington & Jenkins, 1995; Grueneisen et al., 2015; Walker, 2005; Watson et al., 1999) and EF (Ciairano et al., 2007; Priewasser et al., 2013; Riggs et al., 2006) show strong relations to social competence at this age. However, it may be the case that since ToM and EF abilities are related to both pro-social behaviours and more skilled competitive behaviours (Ding et al., 2015; Rakoczy, 2007; Sher et al., 2014; Sidera et al., 2013), in this instance the effects may have cancelled each other out. In other words, children with higher socio-cognitive skills may have been more capable of behaving in a pro-social manner, but due to their better understanding of the nature of competitive gameplay, at this age these abilities may not emerge as predictors of pro-social behaviour towards opponents in competitive environments. Another possibility is that children's ToM and EF skills relate strongly to social behaviour when interacting with others face-to-face, but the nature of the tablet game (competing against an opponent who was not physically present) is capturing an interaction with a more removed (and potentially less socially important) partner. It is possible that if children were playing against real (as opposed to virtual) opponents in-person, that ToM and EF abilities would show stronger relations to their pro-social behaviours during the game.

The final aim of this research was to investigate how parent-reported skills related to social behaviours during this competitive task. The prediction that higher parent-reported social skills and executive functioning abilities would relate to more pro-social behaviours across gameplay outcomes was not found, as neither of the parent-reported measures were related to pro-social behaviours in any condition, after controlling for age and gender. Despite these null findings being contradictory to the hypothesis, there is some evidence in the literature that correlations between behavioural and report measures of social skills can be variable and do not always show significant relations to one another (Caballo, 1993; Wigelsworth, Humphrey, Kalambouka & Lendrum, 2010). Furthermore, none of the in-lab measures of executive functioning were significantly correlated to the parental-report measure of EF (although all in-lab measures of EF were highly correlated). This finding also fits with previous research demonstrating that parental measures of EF do not always correlate to in-lab measures of EF (Liebermann, Giesbrecht & Müller, 2007; Mahone & Hoffman, 2007). It has been suggested that parental-report versus in-lab measures of EF may be measuring different underlying constructs, which is why the relation between the two may be lower than expected (Toplak, West, & Stanovich, 2013). Therefore, this study provides evidence that both social behaviours and executive functioning abilities in laboratory settings do not seem to be capturing how parents perceive their child's social behaviours generally and executive functioning skills in the real world.

Limitations

Although this research presents interesting information regarding children's abilities to navigate competitive contexts, there are limitations that should be addressed when considering the findings.

One limitation was the artificial nature of the interaction between children and their (virtual) opponents. This methodology may be capturing social interaction in the online realm, a paradigm which is becoming more prevalent in children's experiences of the social world. However, as the children were sending messages through the tablet without knowing what types of messages their partner was sending them (until messages were read aloud at the very end of the game), this experiment does not accurately capture the more reciprocal nature of social interaction that occurs between face-to-face opponents in real-life contexts. This may be one explanation for why neither ToM nor EF abilities were found to relate to message pro-sociality, as the true social aspect of the interactions with opponents was limited. Although this limitation was considered when developing the study, it was important to be able to differentiate children's responses to winning versus losing a game (reflecting a main aim of the study), from their responses to the behaviours of their partner. Previous studies have conflated both components of competitive gameplay, making it impossible to disentangle a participant's reaction to feedback on their performance versus the social influence of their partner (Huyder & Nilsen, 2012; Valcke, 2017; Underwood et al., 1999). Although more naturalistic in nature, integrating both components can make it very difficult to ascertain whether participant behaviour was in response to the game outcome, or in response to the behaviour of their opponents.

Furthermore, the nature of having a competitive game on an electronic tablet may have led children to suspect that their opponents were not real. However, the statements that children generated to opponents, as well as other statements made to experimenters throughout the game (e.g., “When do I get to meet Alice?”) suggest that this was not the case for most children in this age range. Only one child expressed after the debriefing session that they had suspected that their opponents were virtual, whereas the vast majority expressed surprise at this fact. However, future research should seek to replicate these results in a more naturalistic environment, in which children are playing against actual peers (though as noted above, this would be difficult to achieve while maintaining experimental control).

One limitation of the coding procedure was that the coders were not blind to the condition when rating the pro-sociality of messages. This was decided in the planning stages as it would be difficult to interpret statements without considering the contextual backdrop. That is, the nuanced meaning of statements to others can only be inferred from a given context or situation (Mishler, 1979). For instance, stating “you did a great job” to your opponent can have different connotations depending on whether you had just won or lost to that person. Thus, it was decided that in this instance, it was necessary for the coders to know the context of each message. Although the coders were not blind to condition, they were blind to any demographic characteristics of participants (e.g., age, gender) that may have possibly influenced their ratings of pro-sociality. Therefore, while the coders knowing the context could impact condition effects, it would not impact the gender effects that were found.

A final limitation of the analyses used in this study is the utilization of a composite variable of EF. It is possible that the EF composite reflects processes outside of EF. For example, the composite variable could reflect children’s overall cognitive ability, a possibility which we attempted to control for in this study with the measure of expressive vocabulary (with verbal skills showing a strong correlation with children's general intellectual abilities; Childers, Durham, & Wilson, 1994). Future research should endeavour to use a latent variable of EF from the three indicators of cognitive flexibility, working memory, and inhibition.

Conclusions

In conclusion, this study shows that pre-school aged children navigate competitive contexts differently depending on whether they are winning or losing a game. Specifically, it was found that children's performance on competitive tasks improved after feedback that they were winning or tying against an opponent, but not after feedback that they were losing. This research also provides new information on how socio-cognitive skills relate to performance in competitive tasks. Executive functioning abilities and gender were found to play a role in children's performance, in that girls with high EF showed greater improvement after receiving feedback that they were winning (compared to girls with low EF who showed less improvement). On the contrary, for boys, EF did not have an influence on performance over time. Theory of mind abilities were found to improve performance in the competitive game regardless of age, gender, vocabulary skills, or whether children believed themselves to be winning or losing. This research also provides novel insights into how gender can influence pro-social behaviours in competitive environments, in that boys showed higher levels of pro-sociality towards opponents when losing, whereas girls showed declining levels of pro-sociality over time after losing to a peer. This research contributes to further understanding on how gameplay outcomes, gender and socio-cognitive abilities impact the extent to which children are able to perform well and engage in appropriate social behaviours in competitive environments.

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Appendix

Table 1

Descriptive statistics for in-lab tasks and parental questionnaires.

Task	*n*	*M*	*SD*
Expressive Vocabulary	102	5.05	2.08
Object Classification Task	101	8.80	2.41
Digit Span	101	9.45	3.28
Inhibition task (standardized residuals)	98	0.01	0.95
Theory of Mind battery	102	5.67	1.24
SSIS	97	92.23	18.45
CHEXI	98	35.90	9.23

Table 2

Bivariate correlations between measures of age, gender, vocabulary, EF, ToM and social skills.

	Expressive Vocabulary	Object Classification Task	Digit Span	Inhibition task (standardized residuals)	Theory of Mind battery	Social Skills (SSIS)	EF (CHEXI)
Age (in months)	.545**	.556**	.552**	.348**	.362**	.093	.040
Gender	-.112	-.035	.005	-.091	-.191	.069	-.014
Expressive Vocabulary	-	.596**	.560**	.338**	.492**	.113	-.291**
Object Classification Task	-	-	.517**	.281**	.260**	.023	-.037
Digit Span	-	-	-	.433*	.430**	-.006	-.121
Inhibition task (standardized residuals)	-	-	-	-	.283**	.150	-.075
Theory of Mind battery	-	-	-	-	-	.064	-.044
Social Skills (SSIS)	-	-	-	-	-	-	-.493**

Gender coded as 0 = girls, 1 = boys

**p≤ .05; **p≤ .01*

Table 3

Bivariate correlations between independent variables (age, gender, vocabulary, executive functioning, theory of mind, social skills) and dependent variables of total or average scores (total performance scores and average pro-sociality scores by condition).

	Total Performance			Average Pro-Sociality		
	Winning	Tying	Losing	Winning	Tying	Losing
Age (in months)	.572**	.438**	.338**	.343**	.050	.247*
Gender	-.159	-.243*	-.239*	-.038	.058	.145
Expressive Vocabulary	.498**	.307**	.206*	.121	.087	.098
EF Composite Score	.553**	.376**	.370**	.112	-.066	-.038
Theory of Mind battery	.447**	.288**	.188	.197	.088	.147
Social Skills (SSIS)	.004	.040	.033	.138	.052	-.023
EF (CHEXI)	-.063	-.134	.051	-.064	-.007	-.100

Gender coded as 0 = girls, 1 = boys

$*p \leq .05$; $**p \leq .01$

Table 4

Bivariate correlations between independent variables (age, gender, vocabulary, executive functioning, theory of mind, social skills) and dependent variables of change scores (performance change scores and pro-sociality change scores over each condition).

	Change Performance			Change Pro-Sociality		
	Winning	Tying	Losing	Winning	Tying	Losing
Age (in months)	.065	.091	-.056	-.110	.015	.010
Gender	.033	.005	.031	-.055	-.048	.276**
Expressive Vocabulary	.032	.121	-.102	.050	.003	.028
EF Composite Score	.133	-.046	-.086	-.114	-.086	.036
Theory of Mind battery	.169	-.009	.035	-.001	.032	-.023
Social Skills (SSIS)	.094	-.106	-.031	.091	.022	.175
EF (CHEXI)	-.017	-.072	.009	.026	-.020	-.058

Gender coded as 0 = girls, 1 = boys

$*p \leq .05$; $**p \leq .01$

Table 5

Bivariate correlations between parent-reported socio-cognitive skills, average pro-sociality scores and change pro-sociality scores by condition, Partial correlations controlling for age and gender in parentheses.

		Social Skills (SSIS)	EF (CHEXI)
Average Pro-sociality	Winning	.138 (.077)	-.064 (-.084)
	Tying	.052 (.047)	-.007 (-.020)
	Losing	-.023 (-.059)	-.100 (-.092)
Change Pro-sociality	Winning	.091 (.166)	.026 (.033)
	Tying	.022 (-.009)	-.020 (-.025)
	Losing	.175 (.118)	-058 (-.060)

**p≤ .05; **p≤ .01*

Figures

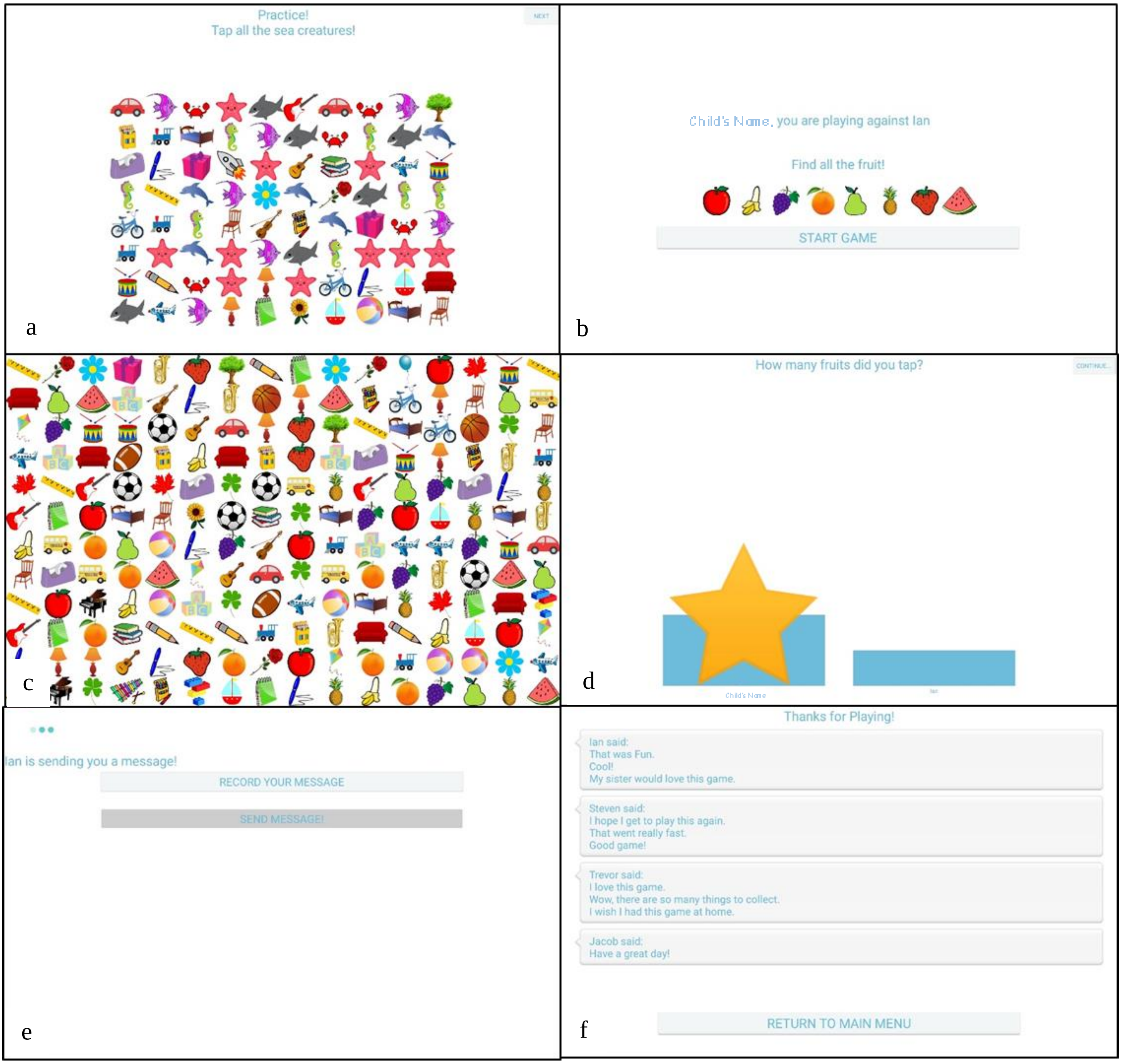

Figure 1: Example of competitive task screens: a) Practice screen; b) Introduction screen; c) Gameplay screen; d) Feedback screen (winning condition; note that experimenter also verbally informs participant about the outcome); e) Record message screen; f) Final message from opponents screen (shown once at the end of all trials).

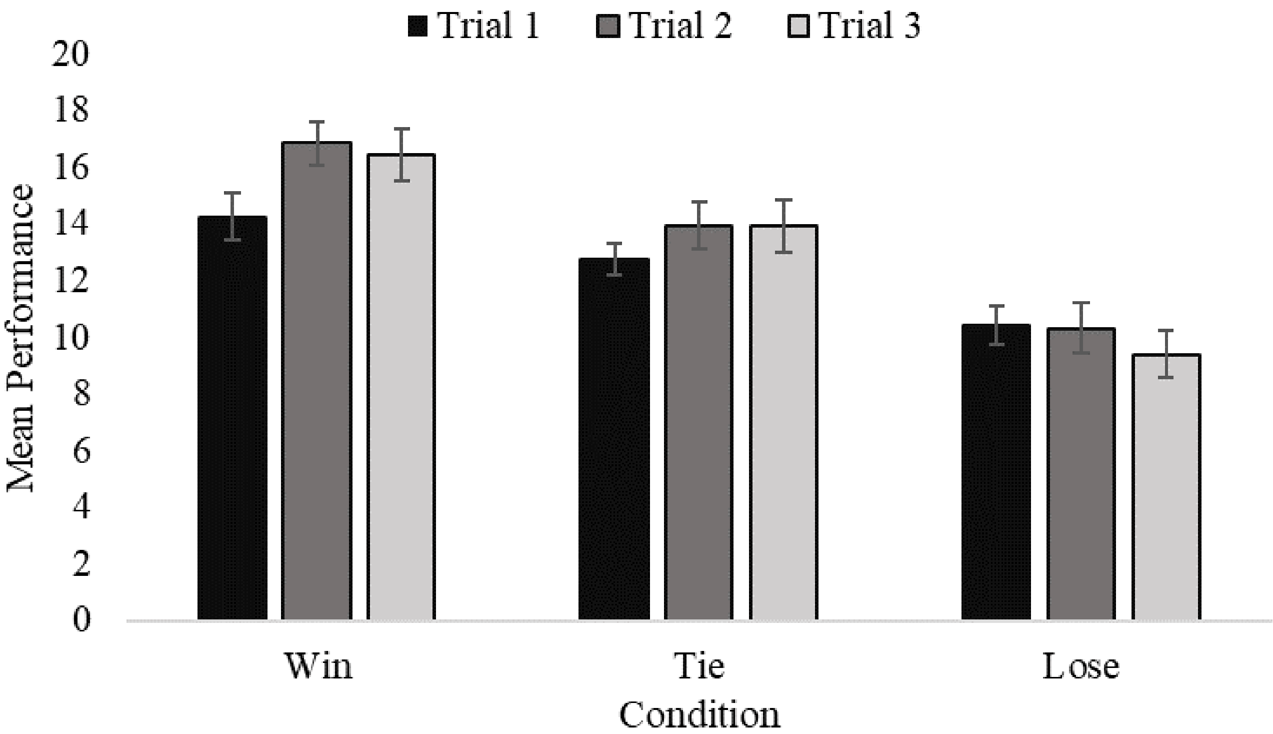

Figure 2: Mean performance scores by condition and trial. Error bars represent standard error.

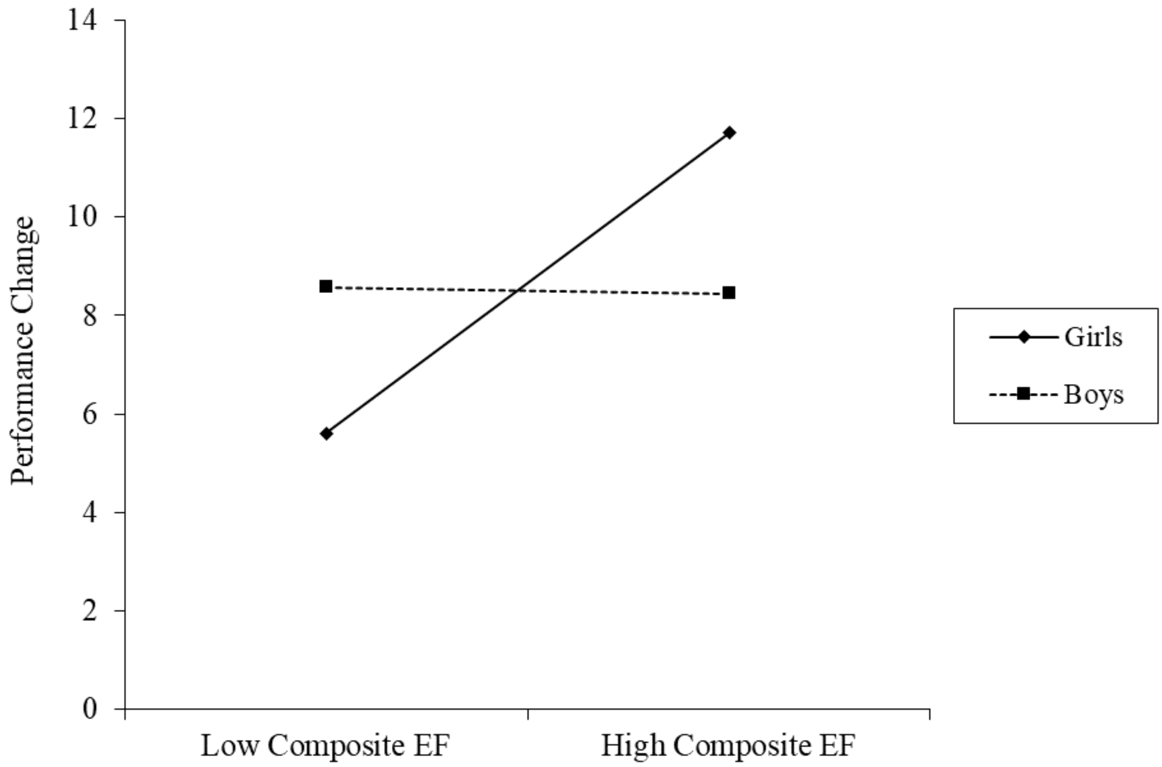

Figure 3: Simple slopes for EF on change in performance in the winning condition, for girls and boys.

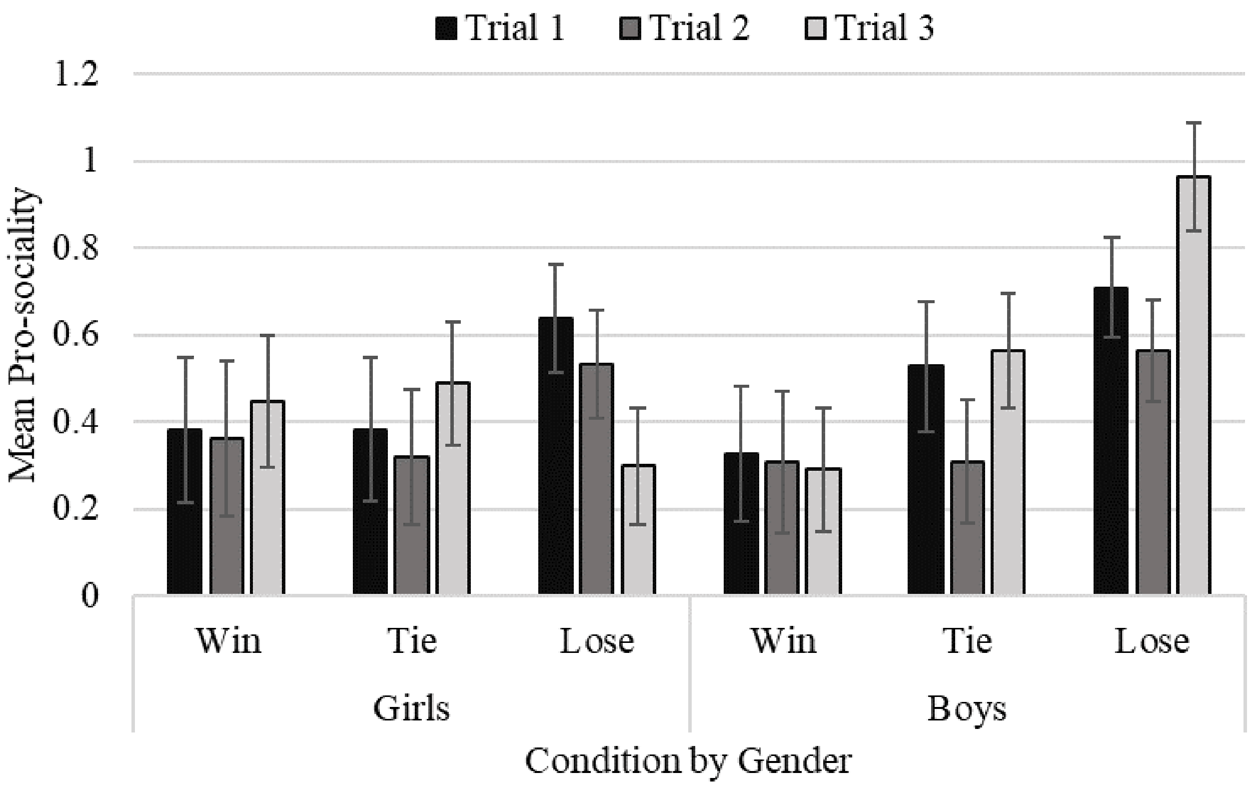

Figure 4: Pro-sociality scores for girls and boys, by condition and trial. Error bars represent standard error.