



## The effects of peer rejection, parent and teacher support on working memory performance: An experimental approach in middle childhood

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### ABSTRACT

Working memory performance, important for children's learning, can be influenced by social interactions. The current study investigates whether parent and teacher support buffer the negative effect of peer rejection on working memory performance, using an experimental approach. Children from third to sixth grade (aged 8–14;  $n = 412$ ) filled out questionnaires and completed an experiment. Working memory performance (Corsi Task Backwards) was measured at the beginning of the experiment. Next, peer rejection was manipulated (Cyberball Task), followed by a manipulation of parent and teacher support (audio message) and a posttest measure of working memory. There was no main effect of peer rejection and parent or teacher support. Social acceptance did moderate the buffering effect of teacher support for working memory performance. Teachers should be aware of the role of their relational support for children's cognition and learning.

### 1. Introduction

Working memory is a limited capacity memory system responsible for temporarily holding information in mind, while processing and manipulating that information (Baddeley, 2010). Working memory has been related to many developmental outcomes, but one area in which working memory is of particular importance is for learning at school. In the classroom, children have to perform many activities in which they have to keep information in mind while performing a complex or mentally challenging activity. Children with low performance on working memory tasks have difficulties in remembering instructions (Alloway, 2006; Alloway, Gathercole, Kirkwood & Elliott, 2009; Gathercole, Durling, Evans, Jeffcock & Stone, 2008; St Clair-Thompson, Stevens, Hunt & Bolder, 2010), solving multistep tasks (Alloway, 2006; Alloway et al., 2009), paying attention during classroom activities (Alloway et al., 2009), reading and reading comprehension (Alloway, 2006; Alloway & Alloway, 2010; De Weerd, Desoete & Roeyers, 2013; Vandenbroucke, Verschueren & Baeyens, 2017b), mathematics (Alloway, 2006; Alloway & Alloway, 2010; De Smedt et al., 2009; De Weerd et al., 2013; Vandenbroucke et al., 2017b), and forming positive relationships with peers and teachers (De Wilde, Koot & van Lier, 2016; McQuade, Murray-Close, Shoulberg & Hoza, 2013).

Because of the importance of working memory for children's classroom functioning and learning, it is critical to understand what factors, especially within the classroom environment, affect working memory

performance. Research has, for a long time, mainly been focusing on the natural development or maturation of working memory. More recently, evidence is accumulating that working memory performance and development does not only influence social experiences, but also can be altered by social experiences (e.g., De Wilde et al., 2016; Morrison & Chein, 2011; Riggs, Jahromi, Razza, Dillworth-Bart & Mueller, 2006; Vandenbroucke, Spilt, Verschueren & Baeyens, 2017a). Specifically, positive social interactions with peers, teachers and parents may promote working memory, while negative interactions with these important social actors may hinder working memory. Despite the growing evidence on the role of social experiences in working memory performance and development, studies examining this topic are scarce and often correlational in nature. The current study investigates the effects of social experiences with peers, parents and teachers on working memory performance adopting an experimental approach.

#### 1.1. Peer experiences and working memory

Especially from middle childhood onwards, relationships with peers become increasingly important and complex. As children move from early childhood to middle childhood, they interact with larger groups of peers. Additionally, focus shifts from simple play to complex, organized, and rule oriented play and eventually to interactions based on communication (Fabes, Martin & Hanish, 2009; Holmes, Kim-Spoon & Deater-Deckard, 2016). Evidence is now accumulating that social

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experiences with peers also have an impact on children's cognitive performance and development. One reason for this is that negative social experiences, such as peer rejection, cause stress. Stress has been shown to negatively impact executive functioning and working memory, potentially because prefrontal brain regions (related to working memory performance) work less optimally when under stress (e.g., excessive release of dopamine and cortisol in prefrontal cortex; Diamond & Ling, 2016; Evans & Schamberg, 2009). Other researchers suggest that stressful social contexts increase the loading on executive functioning and working memory (De Wilde et al., 2016; Williams, 2009). For example, children who are rejected will attempt to restore the relationship, which will require energy and cognitive resources. Consequently, negative social experiences occupy cognitive resources, which cannot be invested in other cognitive tasks.

Indirect evidence comes from studies linking negative experiences with peers, such as being rejected, to brain regions related to executive functioning and working memory, such as the anterior cingulate cortex and prefrontal cortex (Kim, Kroger, Calhoun & Clark, 2015; Lenartowicz & McIntosh, 2005; Will, van Lier, Crone & Güroğlu, 2016). Studies directly linking peer experiences to working memory performance are now also accumulating. Observational studies using a cross-lagged design showed mixed-results depending on the social outcome measured (Holmes et al., 2016; De Wilde et al., 2016). Because these studies are observational in nature, it is difficult to draw conclusions about the causality of these effects. Three experimental studies examined the effect of peer rejection on children's cognitive performance and working memory. They found that some children's cognitive performance is more affected by social experiences compared to other children. A study by Tobia, Riva and Caprin (2017) showed that children who were less accepted by peers or had lower self-esteem were more negatively affected by social exclusion on a reasoning task. This suggests that children who may feel less confident in social situations are more affected by negative social interactions. Hawes et al. (2012) found that girls who were excluded performed worse on working memory tasks than girls who were not excluded, but such an effect was not found for boys. Finally, in an experimental study with a pre-posttest design no effects of social exclusion on working memory performance were found. The current study uses a pre-posttest design to examine changes in working memory performance after an experience of social exclusion in a sample of older children (Vandenbroucke et al., 2017a). Extending this experimental design to older children would provide important insights into the causal effects of peer relationships on working memory performance in an age group where peers start to become more central in children's social context.

### 1.2. The role of support of significant adults

Parents and teachers form attachment figures for children, providing primary sources of support (Roorda, Koomen, Spilt & Oort, 2011). Although peer relationships become more important in middle childhood, interactions and relationships with parents and teachers remain significant factors in children's social life. Children still spend a lot of time interacting with parents and teachers and although the relationship quality with these significant adults generally decreases, research has shown that this relationship quality still predicts developmental outcomes in older children and adolescents (e.g., Hazel, Oppenheimer, Technow, Young & Hankin, 2014; Roorda et al., 2011). Yet, research examining parent-child and teacher-child interactions and relationships in relation to cognition and working memory has focused mainly on preschool-aged children. For example, maternal sensitivity, mind mindedness and maternal autonomy support at 12 months of age predicted executive functioning, including working memory performance, at 18 to 26 months of age (Bernier, Carlson & Whipple, 2010). A meta-analysis of studies with children younger than 8 years of age shows that positive parenting behaviors and cognitive stimulation by the parents predict better working memory (Valcan, Davis & Pino-

Pasternak, 2017). Similarly, positive or negative relationships with teachers have been found to relate to young children's working memory performance. When the teacher-child relationship was characterized by open and warm communication, children performed better on working memory tasks (Commodari, 2013; De Wilde et al., 2016). On the other hand, high teacher-child conflict was related to lower working memory performance (De Wilde et al., 2016). To our knowledge, no studies have examined influences of parents and teachers on older children's working memory. Yet, a meta-regression analysis suggests that the strength of the effect of positive and negative parent behaviors on general executive functioning does not decline for children moving into middle childhood at the age of 8 (Valcan et al., 2017). This suggests that at least parental support might still be relevant for working memory performance of older children, though evidence is limited and, to our knowledge, not available for teacher influences.

As is the case with negative peer relationships, negative parent-child and teacher-child relationships may hinder working memory performance due to heightened stress. Positive interactions with adults who form important attachment figures could buffer against this stress (e.g., Ahnert, Harwardt-Heinecke, Kappler, Eckstein-Madry & Milatz, 2012). As peer rejection might have a negative effect on working memory due to stress and positive interactions with parents and teachers may buffer stress, support from parents and teachers might counteract the negative effect of peer rejection on working memory performance. This idea is supported by previous studies showing that teachers can buffer negative impacts of peer rejection on children's socio-emotional functioning (e.g., Spilt, van Lier, Leflot, Onghena & Colpin, 2014). Such an effect has, to our knowledge, not yet been examined for children's cognitive functioning or working memory performance.

The studies mentioned above are all observational in nature. Experimental studies would provide more compelling evidence on the causality of this relationship. Two studies have previously used such an approach to examine the effect of parents and teachers on children's cognition. One study found that children who had a close relationship with their teacher solved cognitive tasks faster after they had been primed with a picture of their teacher (Ahnert, Milatz, Kappler, Schneiderwind & Fisher, 2013). However, this study examined only the effect of the teacher and used general cognitive measure, while it did not specifically focus on EFs. Similarly, another experimental study, in Grades 1 and 2, showed that when children had a negative relationship with their primary caregiver, they performed better on a working memory task after hearing a supportive audio message from their teacher, while they performed worse after hearing a supportive audio message of their primary caregiver (Vandenbroucke et al., 2017a). This study thus gives a first indication of a causal effect of parent and teacher support, though this effect depends on (parent-child) relationship quality. However, this study did not include any general measure on children's feelings of social acceptance. Based on theory and previous research, it is likely that a single moment of relational support will not be very effective when the child has a general negative idea about social interactions, since the support will not be in line with the beliefs of the child and may thus not be interpreted in such a positive way (Dykas & Cassidy, 2011). Similarly, children who in general do not feel socially accepted (by peers or other social partners) will develop negative ideas about their self and social interactions (e.g., less trust in others) and are less likely to accept support from a parent or teacher (Gorrese & Ruggieri, 2013; Mishna et al., 2016). The current study would provide greater insights into these processes for children in middle childhood.

### 1.3. The current study

In sum, children's interactions with peers, parents and teachers are likely to shape their working memory performance and development. Nevertheless, the number of studies on these topics are limited and often use a correlational design, making it difficult to conclude that negative (or positive) social experiences cause decreases (or increases)

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