

**RESEARCH ARTICLE**

# Preschoolers' cognitive and emotional self-regulation in pretend play: Relations with executive functions and quality of play

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**Abstract**

The preschool period is marked by rapid growth of children's self-regulation and related executive functions. Self-regulation is considered an important aspect of school readiness and is related to academic and social-emotional outcomes in childhood. Pretend play, as part of the early childhood curriculum, is hypothesized to support self-regulation. An important question concerns whether self-regulation should be considered an individual ability or, partly, a situated skill that is influenced by aspects of the classroom context. The aims of this study were to investigate the degree to which 3-year-olds showed cognitive and emotional self-regulation in a naturalistic play setting and to examine how test-based measures of children's cool and hot executive functions and the quality of their pretend play contributed to this observed self-regulation. The results indicated that 3-year-olds showed aspects of cognitive and emotional self-regulation. Cool executive functions appeared significantly related to emotional self-regulation, whereas hot executive functions were not significantly related to cognitive or emotional self-regulation. The quality of pretend play was strongly associated with cognitive self-regulation and, to a lesser extent, emotional self-regulation. The findings of this study suggest that both preschoolers' cool executive functions and the quality of play contributed to their self-regulation skills in naturalistic settings.

**Highlights**

- Preschoolers' cognitive and emotional self-regulation in a naturalistic play setting are two interrelated but separate constructs.
- Children's cognitive executive functions predict observed emotional self-regulation during pretend play.

- The quality of pretend play is strongly associated with children's cognitive self-regulation and, to a lesser extent, emotional self-regulation.

**KEYWORDS**

child care, cognitive and emotional self-regulation, executive function, observations, preschool, pretend play

## 1 | INTRODUCTION

The preschool period is marked by rapid growth of children's self-regulation, generally defined as the ability to control or direct attention, thoughts, emotions, and actions to situational demands in order to reach important personal goals (Bronson, 2000; Diamond & Lee, 2011; Hofmann, Schmeichel, & Baddeley, 2012; McClelland & Cameron, 2012; McClelland, Ponitz, Messersmith, & Tominey, 2010). Self-regulation in preschool children is considered a core aspect of school readiness and has been found to predict academic achievement, social competence, and positive classroom behavior up until late childhood and adolescence (Blair & Diamond, 2008; Calkins & Williford, 2009; McClelland, Acock, & Morrison, 2006; McClelland, Cameron, Connor, et al., 2007; McClelland, Morrison, & Holmes, 2000; Morrison, Ponitz, & McClelland, 2010; Raver et al., 2012; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Although school readiness has previously been more narrowly defined as children's preacademic skills, such as letter and number knowledge or vocabulary (Belsky, Friedman, & Hsieh, 2001), it is increasingly conceptualized as children's ability to express thoughts, plans, and needs verbally; children's enthusiasm, concentration, and persistence in performing a task; and children's sensitivity to other children's perspectives and feelings (McClelland et al., 2006; Rimm-Kaufman, Pianta, & Cox, 2000), which can all be considered aspects of a broad construct of cognitive and emotional self-regulation (Berk, Mann, & Ogan, 2006; Blair, 2002; Bodrova & Leong, 2006; Fantuzzo et al., 2007; Liew, 2012; McClelland et al., 2010). Despite the increasing use of the concept of self-regulation in research and practice as a valuable addition to the traditional concept of school readiness, two questions stand out. First, are the cognitive aspects of self-regulation behavior in the classroom to be distinguished from the emotional aspects? Second, is self-regulation an individual ability or, at least partly, a situated skill in which basic executive functions that underlie the child's self-regulation combined with situational factors facilitate self-regulation as displayed in the classroom? In the classroom context, particularly pretend play is hypothesized as an important vehicle for children to develop self-regulation skills (Berk et al., 2006; Bodrova & Leong, 2006; Vygotsky, 1967). The purpose of this study is to provide initial answers to these questions. Enhancing our understanding of self-regulation and the conditions that facilitate self-regulation can inform classroom practices to support the further development of self-regulation.

### 1.1 | COGNITIVE AND EMOTIONAL SELF-REGULATION

Self-regulation in preschool contexts involves a broad construct including cognitive as well as social and emotional aspects of behavior (Bodrova & Leong, 2006; Liew, 2012; McClelland et al., 2010; Raver et al., 2012; Whitebread et al., 2009). Cognitive self-regulation includes children's use of explicit metacognitive knowledge about thinking and learning processes; strategies to regulate task behavior, such as planning, monitoring, and control of ongoing cognitive processes; and motivation-related factors such as persistence and sustained attention (Bodrova & Leong, 2006; Bronson, 2000; Rothbart, Ellis, & Posner, 2004; Whitebread et al., 2009). Emotional self-regulation behavior in preschool contexts includes children's use of explicit knowledge about emotions, their strategies to control and

modulate expression of emotions, and their ability to meet the social expectations of the situation, to get along and resolve conflicts with peers (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Bodrova & Leong, 2006; Denham, Bassett, et al., 2012). Despite the recognition that self-regulation includes both cognitive and emotional executive control processes, most studies into self-regulation of young children have focused either on cognitive (Bryce, Whitebread, & Szűcs, 2015; Nader-Grosbois & Vieillevoye, 2012; Vieillevoye & Nader-Grosbois, 2008) or on emotional self-regulation (Calkins, Gill, Johnson, & Smith, 1999; Denham, Bassett, et al., 2012; Eisenberg & Sulik, 2012; Graziano, Reavis, Keane, & Calkins, 2007; Trentacosta & Izard, 2007). Moreover, few studies to date have included observational measures in a naturalistic classroom context to investigate children's cognitive and emotional self-regulation. Therefore, the first aim of this study was to investigate whether cognitive and emotional self-regulation can be meaningfully distinguished in preschool children.

## 1.2 | EXECUTIVE FUNCTIONS UNDERLYING SELF-REGULATION

Self-regulated behavior in classroom contexts is presupposed to involve basic cognitive and affective executive control functions (Blair & Ursache, 2011; for a review, see Hofmann et al., 2012). Executive functions refer to operations of the brain, in particular of the dorsolateral prefrontal, anterior cingulate, and parietal cortex and their interconnections (Bush, Luu, & Posner, 2000; Checa & Rosario Rueda, 2011; Rothbart, Sheese, & Posner, 2007). Executive control is required in demanding situations when relevant information (e.g., classroom rules or task goals) must be kept in mind. It is also needed when new information (e.g., an intermediate task outcome) or a different perspective (e.g., another child's contribution to the task) have to be integrated to update the original plan. Finally, it is likely to be required when conflicts emerge and have to be resolved (e.g., between an action result and the task goal), and when different responses compete and a suboptimal response has to be inhibited in favor of a better one (e.g., an automatic or immediately gratifying response vs. a more thoughtful solution to a problem). Although it is plausible that children's executive functions are involved in classroom behavior, in particular in complex social activities that require joint planning, coordination of perspectives, and regulation of impulses and emotions, such as joint pretend play, there is little direct evidence linking measures of children's executive functions to actually displayed self-regulation in classroom activities.

Evidence from neuroimaging and neuropsychological studies indicates that executive control functions operating in "neutral" (or "cool") versus "affect-laden" (or "hot") situations are separable processes and involve partly different neural structures (Bush et al., 2000; Denham, Warren-Khot, et al., 2012; Willoughby, Kupersmidt, Voegler-Lee, & Bryant, 2011). Cool executive function typically includes working memory, or the ability to temporarily hold active and process or update information, inhibitory control, or the ability to suppress an automatic response, to sustain attention and resist interference, and cognitive flexibility, or the ability to shift attention flexibly between different task rules or mind sets (Blair & Ursache, 2011; Blair, Zelazo, & Greenberg, 2005; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). For example, in a cool inhibition task, such as the classic Go-NoGo paradigm (Luria, 1959), children are told to press a key when a particular frequently occurring stimulus appears and to withhold this response when another stimulus appears, to assess their ability to suppress the automatic reaction tendency. In a hot inhibition task, such as the delay of gratification paradigm, a child is asked to try not to touch an attractive sweet or gift in front to assess the ability to suppress the desire to reach for the sweet or gift (Kochanska, Murray, & Harlan, 2000).

The relations between cognitive and emotional self-regulation behavior as displayed in preschool contexts and the underlying cool and hot executive functions, however, may be complex. For example, in studies with school-aged children, working memory has been shown to be positively related to cognitive self-regulation behavior in the classroom, both concurrently (Bryce et al., 2015) and over time (Fitzpatrick & Pagani, 2012). However, in a longitudinal study involving 3- and 4-year-olds, a latent factor, indicated by measures of both cool and hot executive functions, was found to be predictive of children's cognitive self-regulation in the classroom as reported by teachers (Denham, Warren-Khot, et al., 2012). With regard to emotional self-regulation, a cross-sectional study showed that preschoolers

with higher levels of cool inhibitory control were more likely to hide their disappointment upon receiving an unattractive gift and to show a socially more acceptable positive response, compared to preschoolers with lower levels of cool inhibitory control (Hudson & Jacques, 2014). Leerkes, Paradise, O'Brien, Calkins, and Lange (2008) found that a cool executive functions factor, indicated by working memory and cool inhibitory control, was significantly related to emotional self-regulation in 3.5-year-olds. However, Liebermann, Giesbrecht, and Müller (2007) and Martins, Osório, Veríssimo, and Martins (2014) did not find support for an association between cool inhibitory control and emotional self-regulation.

To summarize, there is inconclusive evidence regarding whether cool and hot executive functions are related with cognitive and emotional self-regulation behavior. This study, therefore, includes measures of both cognitive and emotional self-regulation behavior as displayed in the preschool classroom and relates these measures to children's independently assessed cool and hot executive functions.

### 1.3 | QUALITY OF PRETEND PLAY AND SELF-REGULATION

In addition to child factors, such as executive functions, situational factors may contribute to observed self-regulation. In particular, pretend play is considered an important setting for children to develop self-regulation (Berk et al., 2006; Vygotsky, 1967) and forms an important part of early childhood programs. Pretend play requires children to establish a common ground, to coordinate the respective roles, decide together on the global plan and unfolding events, and keep that plan in mind while updating it as the play evolves (Stambak & Sinclair, 1993; Vygotsky, 1967). Sociodramatic play is a form of pretend play in which children themselves become part of the symbolized order and change their personal identities as they take up roles. Sociodramatic play requires children to imagine another person's state of mind and allows them to experiment with emotions (Elias & Berk, 2002; McClelland, Cameron, Wanless, et al., 2007). Despite the strong theoretical claims regarding the role of pretend play in children's self-regulation development, only a limited number of studies have supported such claims (Carlson, White, & Davis-Unger, 2014).

Vieillevoye and Nader-Grosbois (2008) and Nader-Grosbois and Vieillevoye (2012), for example, investigated the relation between pretend play and cognitive self-regulation in 3- to 6-year-old children. A standardized test of pretend play was administered individually to assess children's nonverbal and verbal object substitution and use of pretense. In addition, dyadic peer play was observed and coded for degree of role-taking, pretense actions, and symbolic use of objects. An observational measure was used to evaluate children's planning, focused attention, and self-evaluation as indicators of cognitive self-regulation during play. Both assessments of pretend play were significantly and substantially related to displayed cognitive self-regulation. In another study, involving 4- to 6-year-old children who were observed during free play, the complexity of pretend play, operationalized as the degree of role-play, use of imitation, and make-believe actions, was related to children's attention shifting skill based on teacher ratings (Matthews, 2008).

Associations between pretend play and emotional self-regulation have also been found. In a longitudinal study with 3- and 4-year-old children, Elias and Berk (2002) found that the complexity of children's pretend play, as indicated by higher levels of symbolization and sustained role-play with peers, predicted children's emotional self-regulation behavior a few months later, while controlling for verbal ability. Emotional self-regulation, in this study, included children taking responsibility to clean up and help other children. Studies on 3- to 5-year-old children have also shown relations between the quality of pretend play and emotional self-regulation, assessed either by observing children's response to an emotionally negative event during pretend play (Galyer & Evans, 2001) or by parent or teacher ratings of their behavior (Gilpin, Brown, & Pierucci, 2015; Lindsey & Colwell, 2003). Finally, a study involving 5- to 10-year-old children showed that having higher levels of imagination during a standardized play task was positively related to parent-rated emotion regulation (Hoffmann & Russ, 2012).

To summarize, only few studies to date have empirically examined the relations between children's pretend play and their cognitive or emotional self-regulation behavior. None of these studies have addressed this relationship while including measures of children's displayed cognitive and emotional self-regulation in a single study design. Moreover, although the studies reviewed above provide suggestive evidence on the relations between the complexity of pretend

play and displayed cognitive and emotional self-regulation behavior, none of the studies included measures of children's cool and hot executive functions as control variables. Therefore, the previously observed relationships may, at least partly, be caused by involvement of executive functions in both play behavior (Carlson et al., 2014; Kelly & Hammond, 2011) and self-regulation (e.g., Bryce et al., 2015; Denham, Warren-Khot, et al., 2012). In this study, relations between complexity of pretend play and both cognitive and emotional self-regulation are investigated, while controlling for children's cool and hot executive functions.

## 1.4 | THIS STUDY

This study examined 3-year-olds' self-regulation in center-based education and care provisions and aimed to contribute to the existing knowledge on self-regulation in two ways. First, building on previous studies that mostly looked at either cognitive or emotional aspects of self-regulation, we developed an observational measure to assess both cognitive and emotional self-regulation behavior in a naturalistic classroom setting. Second, we used test-based assessments of children's cool and hot executive functions and an observational measure of the quality of children's pretend play to investigate their respective relationships with children's observed self-regulation behavior. We started by investigating to which extent 3-year-old children's showed cognitive and emotional self-regulation in a naturalistic play situation in the classroom. Next, the following research questions were addressed: (a) Can cognitive and emotional self-regulation be meaningfully distinguished? In line with previous research, we expected the children to show cognitive and emotional self-regulation in play, and cognitive and emotional self-regulation to be related but distinct constructs. (b) To what extent are children's cool and hot executive functions predictive of their observed cognitive and emotional self-regulation during play? On the basis of previous research, we expected children's cool and hot executive functions to be positively related to both cognitive and emotional self-regulation, but given the inconclusive evidence so far, we had no strong expectations as to how cool and hot executive functions are related to cognitive and emotional self-regulation. (c) To what extent is the quality of children's pretend play predictive of their observed cognitive and emotional self-regulation, while controlling for shared variance with children's cool and hot executive functions? Following previous studies, we expected the quality of pretend play in terms of degree of symbolization and role-taking to be positively associated with children's observed self-regulation behavior, independently of children's executive functions.

## 2 | METHOD

### 2.1 | Sample

We used data from an observational in-depth study that was conducted within a large-scale cohort study on the developmental effects of early childhood education and care provisions (pre-COOL study, cf Slot, Leseman, Verhagen, & Mulder, 2015). In pre-COOL, a large cohort of children attending preschool education and day care centers in the Netherlands has been followed up from age 2 to 5 years. At the first measurement wave, 1,819 children across 289 centers participated in pre-COOL. For this study, 87 centers were selected using a purposive sampling procedure to ensure a balanced mix of centers from rural and urban areas and both preschools and day care centers. From the centers that were approached, 44 centers (51%), with 65 classrooms, agreed to participate. Next, classrooms were selected with at least two children who had participated in the first wave of child assessments of the pre-COOL study, and for whom parents had consented to participation in the in-depth study. This yielded 37 classrooms. All children participating in pre-COOL child assessments who were present in these classrooms during the video data collection were included in the current sample ( $N = 95$ ). Additional children ( $N = 18$ ) were randomly selected to increase the number of target children per classroom. This resulted in 113 children, three to four per classroom, of which 59 (52.2%) were boys. For 95 (84%) children, test-based executive function data were available from the first child assessment wave of pre-COOL. Children's mean age at the time of the in-depth study was 37 months ( $SD = 3.5$ ;

range 28–45 months). The majority of children (62.8%) was monolingual with Dutch as their home language. About half of the classrooms provided a half-day program for 2- and 3-year-old children (preschools), and the other half provided a full-day program for 0- to 3-year-old children (day care centers). All teachers ( $N = 37$ ) were female, and most teachers (75.9%) were native Dutch. The majority of the teachers (62.1%) had completed 7 or 8 years of postprimary vocational training. The remainder had a bachelor's degree. Most teachers (79.3%) had worked in the Early Childhood Education and Care field for more than 5 years.

## 2.2 | Procedures

Children's executive functions were assessed when children were on average 28 months old ( $SD = 2.7$ ; range 23–35 months), on average 9 months before self-regulation during pretend play was observed in the in-depth study. Children were tested individually by trained research assistants in a quiet room in their day care center or preschool. Test sessions lasted approximately 45 min. The test battery included tests of executive functions and receptive vocabulary along with a number of other measures not reported in this study (Verhagen, de Bree, Mulder, & Leseman, 2016).

For the in-depth study, classrooms were visited twice during a regular morning. Teachers and children were videotaped for 15 to 20 min in four different situations. Two of these situations were regular daily recurring situations: mealtime and free play. The other situations were guided play situations for which the researchers provided standard sets of play materials (i.e., wooden train tracks and kitchen toys) to all classrooms to ensure comparability between classrooms. This study focused only on the play situation with kitchen toys, such as pots, pans, plates, and cutlery, and different kinds of toy food. The use of realistic-looking objects, for instance kitchen toys, has been found to elicit pretend play, particularly so in children as young as 2 and 3 years (Striano, Tomasello, & Rochat, 2001) and in children from lower socioeconomic backgrounds (Smilansky & Shefatya, 1990) and have been used in earlier research on pretend play (Frahsek, Mack, Mack, Pfalz-Blezinger, & Knopf, 2010; Göncü, 1993; Lewis, Boucher, Lupton, & Watson, 2000; Vieillevoye & Nader-Grosbois, 2008).

Prior to the video recordings, the teacher was asked to select a number of children, with a minimum of four, and to include all the pre-COOL children and a number of additional children present that day. The teacher was further instructed to arrange a play session with these materials, as she would usually do. No further instruction was provided. After 15 min of videotaping, the teacher was told she could end the play session. After 20 min, the research assistant stopped recording.

## 2.3 | Child observational measures

To the best of our knowledge, no observational measures were available at the time of the study to assess simultaneously children's cognitive and emotional self-regulation behavior in a naturalistic setting. For instance, the extensive coding framework developed by Whitebread et al. (2009) mainly focuses on the cognitive aspects of self-regulation and to some extent on motivational aspects but does not include measures of children's emotion regulation, behavioral self-control, or ability to resolve peer conflicts, aspects of interest for the construct of emotional self-regulation in this study. Another framework, the Individualized Classroom Assessment Scoring System (Downer, Booren, Lima, Luckner, & Pianta, 2010), includes aspects of peer interactions relevant for the current purpose, such as resolving conflicts, and also assesses children's task engagement and attention but does not include the metacognitive aspects of cognitive self-regulation, such as planning, monitoring, and control of behavior in view of achieving a goal; nor does it include emotion regulation, one of the aspects of emotional self-regulation in this study. Therefore, we developed a new observation scheme, the Self-Regulation in Play Scale (SRPS), combining cognitive and emotional approaches used in previous studies, which allowed us to assess children's displayed cognitive and emotional self-regulation. In addition, the existing Smilansky Scale for Evaluation of Dramatic and Sociodramatic Play of Smilansky and Shefatya (1990) was adapted to fit the observational procedure of the study (see below).

Each observational measure consisted of several behavioral indicators. The target children for whom executive functions measures were available from the pre-COOL study, three to four per classroom, were rated on each indicator on a 5-point scale, with scores ranging from *low* (1) to *high* (5). A high score was used for children who showed the specified behavior (e.g., metacognitive regulation) frequently, a medium score for children who showed the specified behavior occasionally or only when the teacher stimulated this, and a low score for children who hardly showed the specified behavior, if at all. The observations were conducted by trained research assistants, who scored either the self-regulation scale or the pretend play scale, but never scored both to avoid shared-method variance. Importantly, moreover, the research assistants were blind to the objectives of this study.

### 2.3.1 | Self-Regulation in Play Scale

For this scale, three indicators of cognitive self-regulation were identified on the basis of a review of the literature. *Metacognitive knowledge* refers to the knowledge children express verbally about their own and other children's thinking, learning, and problem solving and includes knowledge about strategies and the effectiveness of Mulder et al., 2014 these strategies (Bronson, 2000; Whitebread et al., 2009). An example of expressing metacognitive knowledge is a child saying "I know how to do this"; an example of knowledge of strategies is a child explaining "When you prepare dinner, you first need to turn on the stove and then put the pan with food on the stove." *Metacognitive regulation* involves the degree to which children use planning, monitoring, control, and evaluation of behavior during play, which includes both verbal behavior and nonverbal behavior (Whitebread et al., 2009). An example of verbal metacognitive regulation is a child stating: "First I am going to make a sandwich and then I will pour a drink," indicating planning behavior. An example of nonverbal metacognitive regulation is a child performing a fluent and coherent sequence of actions showing clear goal setting and monitoring, such as collecting food, a spoon and a pan, putting the food in the pan, and stirring until the meal is ready. *Persistence* captures children's degree of involvement and concentration during play, indicating how long children can sustain an activity and how much effort they are willing to invest when encountering difficulties (Egeland, Erickson, Clemenhagen-Moon, Hiester, & Korfmacher, 1990; Rothbart et al., 2004). Although persistence can be regarded as reflecting motivation (Bronson, 2000), we followed the research by Rothbart et al. (2004) in which persistence was closely related to attentional focusing and, hence, conceived of as part of cognitive self-regulation. An example is a child showing focused attention throughout the observation period and persistence in scooping up food on a plate, even when the food falls on the floor a few times, until the child has succeeded. Internal consistency of the cognitive self-regulation subscale was satisfactory. Cronbach's  $\alpha$  of cognitive self-regulation with all three indicators was .58; but, as will be apparent in Section 3, the factor loading of the indicator metacognitive knowledge was low due to lack of variation in scores and, therefore, excluded from the factor. Cronbach's  $\alpha$  of the final construct, on the basis of the two remaining indicators, was .73.

Four indicators of emotional self-regulation were included on the basis of a review of the literature. *Knowledge of emotions* refers to the knowledge children verbally express about their own and other children's emotions (Whitebread et al., 2009). An example is a child labeling his own or another child's emotion, such as "I am sad." *Emotion regulation* involves deliberate attempts of children to change the nature, intensity, and time course of emotions that are disruptive for the play in order to continue playing (Eisenberg & Spinrad, 2004; Eisenberg & Sulik, 2012). An example is a child who is upset because another child has taken away his toy, and seeks help from the teacher to regulate this negative emotion and to resolve the cause of this emotion in order to continue his play. *Resolving conflicts* refers to children's ability to resolve a peer conflict in a socially acceptable way (de Haan & Singer, 2003; de Haan & Singer, 2010). An example is a child who responds in a verbal way by saying "No that's mine, give it back to me" to a peer who is taking away his toy. Finally, *behavioral self-control* reflects the degree to which children are able to control their behavior, the extent to which they can comply with requests from others, and the degree to which they are able to meet the social expectations of the play situation (Kopp, 1982). An example is a child waiting for a turn to get a toy or to get the teacher's attention. Cronbach's  $\alpha$  of emotional self-regulation based on all four indicators was .68. However, as will be apparent in Section 3, there was very little variation in the scores



for the indicator knowledge of emotions, so this indicator was removed with a resulting Cronbach's  $\alpha$  of .78 for the remaining three indicators.

### 2.3.2 | Pretend play

The Smilansky Scale for Evaluation of Dramatic and Sociodramatic Play (Smilansky & Shefatya, 1990) was adapted for this study as a measure of the quality of pretend play, defined in terms of the complexity of role-play and symbolization. The original Smilansky Scale was designed for observations based on time sampling. For this study, the scale was adapted to fit the global rating procedure used for the other observational measures and based on the full length of the video.

The adapted scale included four indicators of children's pretend play, which were each scored on a 5-point scale. *Role-play* assesses the degree to which children enact roles by imitative action or verbalization during the play episode. A high score reflects a child showing sustained elaborate role-play throughout the play episode. *Make believe* reflects the degree of object substitution (using a toy for something else than its intended) and verbal substitution of actions and situations (verbal descriptions of an action in an imaginary situation, e.g., "I am going to the supermarket"). A high score reflects a child using object substitution on multiple occasions or verbally describing actions or situations. *Interaction* assesses the degree to which children direct words or actions to others (peers and the teacher) in play and communicate within the play episode (within-frame talk as part of the play). A high score reflects a child who has reciprocal interactions with other children and frequently uses within-frame talk. Finally, an additional indicator not present in the original scale of Smilansky and Shefataya was *metacommunication*, which reflects the degree of outside-frame talk, such as assigning roles and discussing the course of the play as it evolves (Verba, 1993). Metacommunication, by definition, assumes interaction between two or more children and is considered a mature form of mutual play regulation (Whitebread & Sullivan, 2012). Internal consistency of the scale was satisfactory (Cronbach's  $\alpha = .78$ ).

### 2.3.3 | Training and interobserver reliability

Seven research assistants were trained on the SRPS, and another four were trained on the adapted Smilansky Pretend Play Scale by the first author. Following a training of two half-days, the assistants coded two videos independently to determine reliability prior to data collection. For the SRPS, six assistants passed the preset reliability criterion of 80% agreement within one scale point difference for all indicators with the first author (chance level agreement is 52%) and were allowed to continue with data coding. For the Smilansky Pretend Play Scale, all four assistants passed the same preset reliability criterion and could continue with data coding.

In addition, part of the data (at least 18%) was coded independently by both the first author and each assistant to determine interobserver reliability in order to calculate intraclass correlation coefficients for the total scales. The *average measures* intraclass correlation coefficients for the total scales, using a two-way mixed-effects model with absolute agreement, averaged across assistants, were 0.81, 0.76, and 0.77 for cognitive self-regulation, emotional self-regulation, and pretend play, respectively.

## 2.4 | Children's executive functions

Two separate cool and hot executive function construct scores were obtained using the latent factor scores of a confirmatory factor analysis involving the full pre-COOL sample. The tasks used as indicators for each of the two measures are briefly described below. Detailed task descriptions and the factor analysis are reported elsewhere (Mulder et al., 2014).

### 2.4.1 | Cool executive functions

Children's scores on a selective attention task and two working memory tasks were used as indicators of the cool executive functions construct. *Selective attention* was assessed with a visual search task in which children had to



identify targets amidst a display of distractors as fast as possible. This task was administered on a laptop computer and designed for the purposes of the pre-COOL study, based on previous work by Gerhardstein and Rovee-Collier (2002) and Scerif, Cornish, Wilding, Driver, and Karmiloff-Smith (2004). The average number of targets identified across three trials was scored. *Visuospatial short-term memory* was assessed with a memory for location task in which children had to remember the location of hidden toys (Oudgenoeg-Paz, Volman, & Leseman, 2015; Pelphrey et al., 2004; Vicari, Caravale, Carlesimo, Casadei, & Allemand, 2004). Six identical white boxes were used as hiding locations. The task was given in an adaptive fashion, and the number of toys hidden in subsequent trials ranged from one to four. The number of locations children could remember simultaneously was counted to obtain a measure of their short-term memory span. *Visuospatial working memory* was measured with the Six-Boxes Task (Diamond, Prevor, Callender, & Druin, 1997). In this task, children watched while six toys were being hidden in six identical white boxes. Children were then asked to find the toys by opening one box at a time, requiring them to update working memory in order to avoid opening the same box again, with a 6-s delay in between consecutive search attempts. The total number of toys found in six search attempts was scored.

### 2.4.2 | Hot executive functions

Children's scores on a *snack delay* and a *gift delay* task were used as indicators of the hot executive functions construct (Kochanska, Murray, & Coy, 1997; Kochanska, Murray, Jacques, Koenig, & Vandergeest, 1996; Kochanska et al., 2000). Children were shown an attractive object, a snack, and a gift, respectively, and asked to try not to touch the object until the research assistant had finished another task. The research assistant then turned and moved away to a distant corner of the room, supposedly to make notes on an unrelated topic. The delay time was 1 min in both tasks. During the delay, the assistant scored whether children touched the object and recorded their specific actions (e.g., eating the raisins and tearing the wrapping paper). For both the snack and gift delay task, a score was computed on the basis of whether children showed these behaviors (sum score of "present," coded as 1, or "absent," coded as 0, for each behavior; gift delay: touching the bow or gift wrap, tearing the wrapping paper; snack delay: touching or picking up the box or raisins, eating the raisins).

Psychometric quality of the executive functions test battery was found to be satisfactory (Mulder et al., 2014). Factor loadings for each of the indicators of the hot and cool executive functions latent constructs were  $\geq 0.77$  and  $\geq 0.41$ , respectively (all  $ps < .001$ ). Moreover, the two executive functions constructs were significantly related to parent and teacher reports of the conceptually related temperament dimensions attentional focusing and inhibitory control (Mulder et al., 2014).

### 2.4.3 | Control variables

Several child background characteristics were included for control purposes. Two dichotomous variables were constructed to represent *gender* (1 = *female*; 0 = *male*) and *home language* (1 = *only Dutch*; 0 = *other language(s) as well*) on the basis of parent reports. Children's *age* in months was added as a continuous variable. Due to differences in day care enrolment age, the age at which the executive functions assessment was conducted differed between children (ranging from 23 to 35 months). To control for differences in the time elapsed between the executive functions assessment and the observation of self-regulation, we constructed the variable *time between test and observation*. Finally, as prior research has shown that children's vocabulary skills are related to executive functions (Fuhs & Day, 2011; Valloton & Ayoub, 2011), we included receptive Dutch *vocabulary* measured with the Dutch version of the Peabody Picture Vocabulary Test (Dunn, Dunn, & Schlichting, 2005) as a covariate. A shortened version was used consisting of 24 items, with good internal consistency (Cronbach's  $\alpha = .88$ ). Scores were calculated as the percentage of correct responses for each child (Verhagen et al., 2016). In our main analyses, all control variables were included as covariates, except gender, which did not show any relation with the outcome measures or any of the other variables.

## 2.5 | Analysis strategy

To answer our first research question, we took a number of steps. First, descriptive statistics were computed to examine the degree of variation in children's self-regulation and pretend play for each of the indicators. Second, for descriptive purposes, the correlations between the indicators of cognitive and emotional self-regulation and quality of pretend play were examined. Next, confirmatory factor analysis was performed in Mplus (version 7; Muthén & Muthén, 1998–2012) to evaluate the factor structure of cognitive and emotional self-regulation, and to test whether these measures represented distinguishable constructs rather than a single broad self-regulation factor. The maximum likelihood robust (MLR) estimator was used to deal with the non-normality of some of the indicators. The factor scores extracted from these analyses were used in subsequent analyses instead of retaining the complete measurement model, in order to reduce the number of parameters in the final model. This was deemed necessary given the small sample size.

Not all children received a score on the indicators emotion regulation and resolving conflicts of the SRPS, because, for some children, situations requiring emotion regulation or conflict resolution did not occur in the observed play episodes. These missing values can be considered planned, because they are inherent to the way in which both indicators were defined. Although these missing values, therefore, cannot be considered to be completely at random, missing data were dealt with by using full information maximum likelihood estimation in Mplus (Enders, 2010), in which the standard errors of the parameter estimates are computed using the complete observed information matrix (Muthén & Muthén, 1998–2012). Children with and without missing data on these indicators did not differ systematically in scores on the other indicators. Cognitive and emotional self-regulation were estimated in the same model, allowing Mplus to impute values for the missing scores in indicators using all information available in the other indicators of both latent constructs. To check robustness of the findings, we calculated correlations between the extracted factor scores with the missing data estimated by Mplus and the mean scale scores based on the observed values of the indicators only. Correlations were large ( $r = .97$  for cognitive self-regulation and  $r = .89$  for emotional self-regulation; both  $ps < .001$ ).

Pretend play was considered a potential predictor of children's self-regulation in this study. Therefore, a separate model was estimated to test the factor structure of the pretend play construct. Again, the estimated factor scores were extracted and used in the subsequent analyses.

To address our second and third research questions, we applied structural equation modeling to investigate the multivariate relations between children's observed cognitive and emotional self-regulation, on the one hand, and test-based cool and hot executive functions and the complexity of pretend play, on the other hand. The models that were examined are similar to ordinary multiple regression analyses, in which estimates of the unique effects of the independent variables on the dependent variable are obtained after specifying all covariances between the independent and control variables. We controlled for children's vocabulary and background characteristics (age, home language, and the time elapsed between tests and observation). Children were nested within classrooms (Hox, 2010) with intraclass correlations of  $\rho = 0.021$  for cognitive self-regulation,  $\rho = 0.041$  for emotional self-regulation, and  $\rho = 0.201$  for pretend play, respectively. We controlled for this nesting by using the `type = complex` option in Mplus.

Model building proceeded in a number of steps. First, the nonrestricted baseline models were estimated using the MLR estimator. Second, the models were trimmed by eliminating nonsignificant paths with  $p > .10$  or with  $|\beta| < .05$  (Wuensch, 2012) in a step-by-step fashion to obtain the most parsimonious model. Model fit was evaluated on the basis of several fit indices: the chi-square test of goodness of fit, the comparative fit index (CFI) and the standardized root mean square residual (SRMR) at both the child and classroom level, with a nonsignificant chi-square,  $CFI > 0.95$ ,  $SRMR < 0.05$  indicating good fit. The root mean square error of approximation was not used to evaluate model fit, because recent evidence suggests this index often falsely indicates poor model fit in small samples or in models with a small number of degrees of freedom (Kenny, Kaniskan, & McCoach, 2014). Standardized regression coefficients  $\beta$  were used as measures of effect size with  $\beta$  around  $.10$  indicating a small effect,  $\beta$  around  $.30$  a medium-sized effect, and  $\beta > .50$  indicating a large effect (Kline, 2005). Given the relative small sample size of this study, a bootstrapping

procedure was used as a robustness check for all final models using the ML estimator (MPlus does not provide the bootstrapping option for the MLR estimator) without a correction for the nesting of children in classrooms (MPlus does not provide the bootstrapping option in type = complex models). Good model fit of both the basic structural equation models and the models using bootstrapping indicates robustness of the models and resulting parameters (Kline, 2005).

### 3 | RESULTS

Descriptive statistics for all indicators of cognitive and emotional self-regulation and pretend play are shown in Tables 1 and 2. Regarding cognitive self-regulation, the scores for metacognitive knowledge were very low on average and variation was limited. About 6% of the children received a slightly higher score, indicating that at least some children showed explicit metacognitive knowledge, such as knowledge of strategies. Children's use of metacognitive strategies and displayed persistence during play yielded higher mean scores, with most scores varying between low/mid and high. Concerning emotional self-regulation, children did not show explicit knowledge of emotions during the play episode, with one exception. About 65% of the children obtained a score on emotion regulation. The remaining children did not show emotions that could threaten the continuity of the play session. For the children who

**TABLE 1** Descriptive statistics for the observed self-regulation and children's pretend play

Self-regulation indicator	M	SD	Range	N
Metacognitive knowledge	1.11	0.43	1–3	113
Metacognitive regulation	2.58	0.97	1–5	113
Persistence	3.24	1.16	1–5	113
Knowledge of emotions	1.02	0.19	1–3	113
Emotion regulation	3.66	1.08	1–5	73
Resolving conflicts	3.53	1.16	1–5	88
Behavioral self-control	3.54	1.04	1–5	113
Role-play	2.31	1.33	1–5	113
Make believe	2.46	1.23	1–5	113
Interaction	2.11	1.25	1–5	113
Metacommunication	1.17	0.50	1–3	112

**TABLE 2** Frequency distribution of children's self-regulation during play

Self-regulation indicator	Low	Low/mid	Mid	Mid/high	High
Metacognitive knowledge, frequency (%)	106 (93.8)	2 (1.8)	5 (4.4)	0	0
Metacognitive regulation, frequency (%)	13 (11.5)	45 (39.8)	35 (31.0)	17 (15.0)	3 (2.7)
Persistence, frequency (%)	7 (6.2)	21 (18.6)	46 (40.7)	16 (14.2)	23 (20.4)
Knowledge of emotions, frequency (%)	112 (99.1)	1 (0.9)	0	0	0
Emotion regulation, frequency (%)	2 (2.7)	6 (8.2)	29 (39.7)	14 (19.2)	22 (30.1)
Resolving conflicts, frequency (%)	5 (5.7)	9 (10.2)	32 (36.4)	18 (20.5)	24 (27.3)
Behavioral self-control, frequency (%)	2 (1.8)	16 (14.2)	39 (34.5)	31 (27.4)	25 (22.1)
Role-play, frequency (%)	42 (37.2)	26 (23.0)	26 (23.0)	6 (5.3)	13 (11.5)
Make believe, frequency (%)	29 (25.7)	33 (29.2)	33 (29.2)	6 (5.3)	12 (10.6)
Interaction, frequency (%)	52 (46.0)	19 (16.8)	28 (24.8)	6 (5.3)	8 (7.1)
Metacommunication, frequency (%)	99 (87.6)	7 (6.3)	6 (5.4)	0	0

showed disruptive emotions, scores were in the mid to high range, indicating that children were, on average, quite able to regulate their emotions and to continue their play, but sometimes needed help from the teacher. Peer conflicts were quite common, given that almost 78% of the children received a score on the indicator resolving conflicts. On average, children scored in the mid to high range on this indicator, indicating that they were able to resolve conflicts themselves most of the time, but occasionally needed help from the teacher. Finally, children's behavioral self-control was in the mid to high range on average, indicating that children were mostly able to adapt to the situational demands of the play setting.

Regarding pretend play, children showed medium levels of role-play and make-believe actions, and they had some interactions with either peers or the teacher during play. Metacommunication occurred much less frequently but did show some variation, with 12% of the children occasionally engaging in metacommunication during play.

The results of the confirmatory factor analysis showed that cognitive and emotional self-regulation were indeed two related but distinct constructs, which seems apparent from the correlational pattern presented in Table 3. The indicator knowledge of emotions was excluded from this analysis, because of its low occurrence and severely limited variance. Factor analysis revealed good model fit for the two-factor model ( $\chi^2(8) = 11.29, p = .19$ ; CFI = 0.97; SRMR = 0.04), and factor loadings were satisfactory, except for metacognitive knowledge, which had a nonsignificant factor loading of 0.18. Therefore, this indicator was also excluded from the model. Fit of the final model was acceptable ( $\chi^2(4) = 9.43, p = .05$ ; CFI = 0.95; SRMR = 0.04) and confirmed two moderately interrelated but distinct constructs of self-regulation (see Figure 1). An alternative one-factor model, also without the indicators metacognitive knowledge and knowledge of emotions, showed very poor model fit ( $\chi^2(5) = 173.65, p = .00$ ; CFI = 0.00; SRMR = 0.15). Factor scores from the two-factor model were extracted and used in further analyses.

The same procedure was followed for modeling pretend play as a latent factor (see Figure 2). Model fit and all factor loadings were satisfactory ( $\chi^2(2) = 5.429, p = .067$ ; CFI = 0.98; SRMR = 0.03). Although the factor loading of metacommunication was relatively low, it was above the suggested cutoff value of 0.32 (Tabachnik & Fidell, 2007). The extracted factor scores were used in the subsequent analyses.

Next, the multivariate relationships of children's observed self-regulation with test-based measures of cool and hot executive functions, and the observed quality of pretend play were investigated, controlling for time between assessments, and children's background characteristics, vocabulary, and nesting within classrooms. Bivariate correlations between child characteristics, children's observed self-regulation, test-based executive functions, and

**TABLE 3** Bivariate correlations between indicators of self-regulation and pretend play

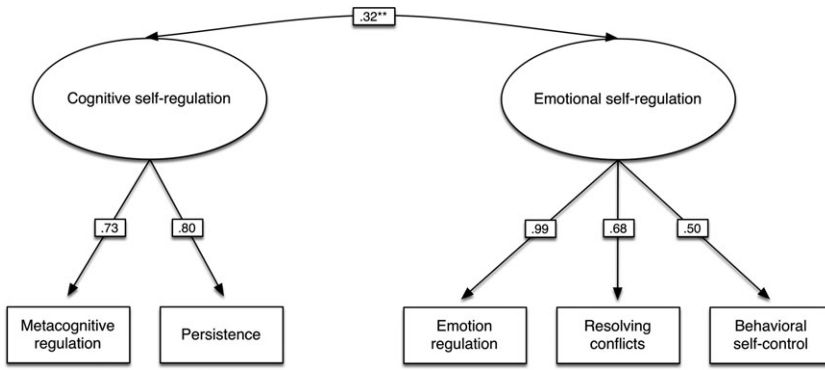
	2	3	4	5	6	7	8	9	10	11
1. Metacognitive knowledge	0.11	0.16 <sup>†</sup>	0.42**	-0.09	0.04	0.01	0.11	0.17 <sup>†</sup>	0.08	0.16 <sup>†</sup>
2. Metacognitive regulation		0.58**	0.04	0.24*	0.27*	0.01	0.45**	0.42**	0.42**	0.24*
3. Persistence			-0.02	0.24*	0.32*	0.14	0.44**	0.40*	0.42**	0.21*
4. Knowledge of emotions				-0.07	-0.05	0.04	-0.02	0.04	0.07	-0.03
5. Emotion regulation					0.65**	0.53*	0.26*	0.22 <sup>†</sup>	0.22 <sup>†</sup>	0.30*
6. Resolving conflicts						0.32**	0.18 <sup>†</sup>	0.23*	0.19 <sup>†</sup>	0.24*
7. Behavioral self-control							0.11	0.06	0.01	0.04
8. Role-play								0.75**	0.64**	0.31**
9. Make believe									0.65*	0.38**
10. Interaction										0.43**
11. Metacommunication										

\*\*\* $p < .001$ ;

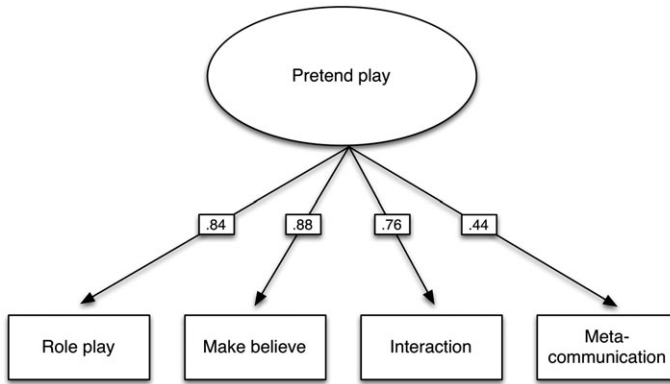
\*\* $p < .01$ ;

\* $p < .05$ ;

<sup>†</sup> $p < .10$ .



**FIGURE 1** Factor structure of cognitive and emotional self-regulation



**FIGURE 2** Factor structure of pretend play

observed quality of pretend play are shown in Table 4. Separate structural equation models were estimated with observed cognitive and emotional self-regulation as outcome measures, respectively, while specifying all covariances between the independent and control variables. In the first model for both outcome measures, the associations with cool and hot executive functions were examined. As this model was saturated, no fit indices could be computed. Model trimming was performed to obtain a more parsimonious model by constraining nonsignificant paths and paths with  $|\beta| < .05$  to zero in a stepwise fashion starting with the smallest coefficients. The trimmed model fitted the data well ( $\chi^2(4) = 0.23, p = .994; CFI = 1.00; SRMR = 0.007$ ); see Table 5. Cool executive functions were positively related to emotional self-regulation, but not to cognitive self-regulation. Hot executive functions were not related to observed cognitive self-regulation and showed a trend for a negative relation with observed emotional self-regulation.

In the second model, the quality of pretend play was entered as a predictor, resulting in a saturated model. To obtain a more parsimonious model, we again constrained nonsignificant paths to zero. This model fitted the data well ( $\chi^2(8) = 0.945, p = .999; CFI = 1.00; SRMR = 0.016$ ). In this model, the quality of pretend play was strongly related to children's cognitive self-regulation. Pretend play was also significantly associated with children's emotional self-regulation, but the effect size was smaller. Note that cool executive functions were still positively related to emotional self-regulation (medium-sized effect), whereas the previous trend-level negative relation of hot executive functions with emotional self-regulation disappeared after including quality of pretend play in the model.

**TABLE 4** Bivariate correlations between child characteristics, executive function, self-regulation, and pretend play

	2	3	4	5	6	7
1. Age at test <sup>a</sup>	0.21*	0.23*				
2. Cool executive functions		0.80***		0.06	0.28**	0.11
3. Hot executive functions				-0.06	0.16	-0.09
4. Age at observation <sup>b</sup>				0.15	0.10	0.20*
5. Cognitive self-regulation					0.39**	0.54**
6. Emotional self-regulation						0.24*
7. Pretend play						

<sup>a</sup>Children's age during the test was only used to investigate correlations with children's executive functions skills as assessed at the test assessment.

<sup>b</sup>Children's age during the observations was only used to examine correlations with children's self-regulation and pretend play behavior during the observational assessment.

\*\*\* $p < .001$ ;

\*\* $p < .01$ ;

\* $p < .05$ .

**TABLE 5** Associations between cognitive and emotional self-regulation with cool and hot executive functions and complexity of pretend play ( $N = 113$ )

	Cognitive self-regulation			Emotional self-regulation		
	B	SE B	$\beta$	B	SE B	$\beta$
Model 1						
Age	0.01	0.02	.06	0.05	0.04	.19
Home language	#			#		
Time between test and observation	0.05	0.03	.21	-0.03	0.04	-.07
Vocabulary	0.34	0.22	.25	-0.43	0.24	-.15 <sup>†</sup>
Cool executive functions	0.22	0.14	.19	0.67	0.21	.48**
Hot executive functions	-0.35	0.21	-.26 <sup>†</sup>	-0.46	0.29	-.15
Model 2						
Age	0.01	0.02	.07	0.06	0.03	.21 <sup>†</sup>
Home language	#			#		
Time between test and observation	#			-0.07	0.03	-.20*
Vocabulary	0.29	0.21	.16	-0.46	0.18	-.16 <sup>†</sup>
Cool executive functions	#			0.47	0.22	.33*
Hot executive functions	-0.07	0.12	-.05	-0.21	0.30	-.10
Pretend play	0.57	0.09	.50***	0.46	0.18	.26*

Note. # indicates paths constrained to zero.

\*\*\* $p < .001$ ;

\*\* $p < .01$ ;

\* $p < .05$ ;

<sup>†</sup> $p < .10$ .

## 4 | DISCUSSION

Children's self-regulation, as part of the broader concept of school readiness, develops rapidly in the preschool period (Blair & Diamond, 2008; Bronson, 2000) and is an important predictor of school achievement and positive social-behavioral outcomes in later years (Calkins & Williford, 2009; McClelland, Cameron, Connor, et al., 2007; McClelland et al., 2000, 2006; Morrison et al., 2010; Raver et al., 2012; Rimm-Kaufman et al., 2009). In view of supporting children's self-regulation development in early childhood education and care provisions, it is important to gain more insight into how children regulate their cognitive and emotional behavior in naturalistic classroom activities and to what extent these activities may provide contexts for further self-regulation development.

This study showed that children as young as 3 years are capable of cognitive and emotional self-regulation during pretend play, as observed with the newly constructed SRPS. The children in this study displayed metacognitive regulation of their play behavior, as evidenced by verbal and nonverbal instances of planning, monitoring, and control. This finding is in line with previous research with children of the same age (Nader-Grosbois & Vieillevoys, 2012; Vieillevoys & Nader-Grosbois, 2008; Whitebread, Bingham, Grau, Pino Pasternak, & Sangster, 2007). Children also showed medium to high levels of persistence during play. However, only a few children expressed explicit metacognitive knowledge, indicating that this aspect of cognitive self-regulation is still in an early stage of development at this age, corroborating findings from previous studies (Whitebread et al., 2007, 2009). Alternatively, it is possible that metacognitive knowledge is present at this age but could not be observed in the pretend play activity examined in this study.

Concerning emotional self-regulation, the results indicated that, if needed, children were quite well able to regulate their emotions by modulating and managing the intensity and expression of emotions that were potentially disruptive to their play. Furthermore, children were quite capable to solve (mild) conflicts with peers, which were rather common but seldom disruptive (see also de Haan & Singer, 2010). Occasionally, help of the teacher was needed to resolve conflicts. Finally, children were, on average, able to successfully adapt their behavior to social-situational demands, as evidenced by their ability to wait for a turn or share toys. However, children did not show evidence of explicit meta-emotional knowledge at this age. Although previous research has shown that children at age 3 years are able to recognize and label emotions, this is probably only the case when this is explicitly asked for (Denham, Bassett, et al., 2012). The current play situation may not have provided strong enough triggers in this regard. Furthermore, about one third of the children did not show overt emotion regulation. A likely explanation is that for them the need to do so was absent. Note that in most research on young children's emotion regulation, special paradigms have been used in which strong emotions are deliberately elicited (e.g., Calkins et al., 1999; Galyer & Evans, 2001).

A confirmatory factor analysis showed that cognitive and emotional self-regulation during play presents two interrelated, but separate, constructs. This finding is in line with theoretical accounts of self-regulation, as well as with evidence from neuroimaging and executive function studies showing a similar distinction (Blair & Diamond, 2008; Bodrova & Leong, 2006; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Bush et al., 2000; Denham, Warren-Khot, et al., 2012; Willoughby et al., 2011). The current results extend these previous findings to self-regulation behavior in a naturalistic context.

The second aim of this study was to examine the relations between children's cool and hot executive functions as assessed with a test battery several months prior to the observations and their observed self-regulation in a naturalistic setting. With previous research, we expected both cool and hot executive functions to be related to observed cognitive and emotional self-regulation. However, given the inconclusive evidence until now, we had no strong expectations as to how cool and hot executive functions would be related to cognitive and emotional self-regulation. We found medium-sized positive associations between cool executive functions and observed emotional self-regulation, while controlling for children's age, home language, and vocabulary. Our results confirm findings of previous studies (Hudson & Jacques, 2014; Leerkes et al., 2008) and fit in with theoretical models of self-regulation that emphasize the role of cool executive functions, in particular attention (part of the cool executive



functions factor in our study; Mulder et al., 2014 in the broader concept of self-regulation (Blair & Ursache, 2011; Blair et al., 2005; Morrison et al., 2010). A trend for a negative relationship between hot executive functions and observed cognitive self-regulation appeared, when controlling for child characteristics and cool executive functions. A possible explanation is that children high on hot executive functions are overcontrolling their emotions (Eisenberg et al., 2004) and lack drive in their play (Fantuzzo, Bulotsky-Shearer, Fusco, & McWayne, 2005).

Hot executive functions were not associated with children's observed emotional self-regulation during play, which may seem counterintuitive. The delay of gratification tasks that were used to measure hot executive functions required children to resist temptation and exert behavioral self-control. Therefore, hot executive functions are conceptually related to the indicators behavioral self-control and conflict resolution of the emotional self-regulation scale used in this study, which both involved control of affect-driven behavioral impulses. Indeed, the separate correlations between hot executive functions and these indicators were positive and statistically significant, albeit not very strong ( $r = .22$  with behavioral self-control and  $r = .27$  with resolving conflicts;  $ps < .05$ ). Yet the broader construct of emotional self-regulation also included an indicator addressing the expression, instead of inhibition, of positive (e.g., enthusiasm) and negative affect (e.g., frustration) in a regulated, socially acceptable way, which was not correlated with hot executive functions ( $r = .08$ ,  $p = .54$ ). Taken together, the present results suggest that the construct of hot executive functions based on affect-inhibition and the construct of emotional self-regulation during play only partly overlap.

The lack of a significant relationship between cool executive functions and observed cognitive self-regulation is more difficult to explain. Further exploration of the data revealed no significant correlations between cool executive functions and the separate indicators of cognitive self-regulation. This suggests that the concepts of cool executive functions, involving selective attention and visuospatial working memory in this study, and cognitive self-regulation as defined here, with an emphasis on metacognitive functioning in a play setting are unrelated, despite the fact that, at a more abstract conceptual level, both refer to optimal behavioral adaptation to situational demands.

The third aim of this study was to examine the concurrent associations between observed cognitive and emotional self-regulation and the quality of children's pretend play. Overall, associations between cognitive self-regulation and pretend play were strong, even when controlling for children's executive functions and other child (background) characteristics, which is in line with previous studies (Matthews, 2008; Nader-Grosbois & Vieillevoye, 2012; Vieillevoye & Nader-Grosbois, 2008). Pretend play requires children to coordinate their goals, negotiate plans, monitor their play and the children they play with as the play progresses, and adapt their actions accordingly. Hence, complex pretend play requires metacognitive regulation strategies and persistence. Besides a significant positive relationship between cognitive self-regulation and pretend play, we also found a positive and significant relationship between emotional self-regulation and pretend play, while controlling for children's executive functions. This result corroborates previous research too (Cemore & Herwig, 2005; Elias & Berk, 2002; Galyer & Evans, 2001; Gilpin et al., 2015; Lindsey & Colwell, 2003; Hoffmann & Russ, 2012) and provides additional support for the hypothesis that pretend play is a situation in which children learn to express and manage (imitated and imagined) emotions in socially desirable ways.

There are a number of limitations to this study. First, the study was small scale and involved a deliberately selected sample. Therefore, we are not able to draw strong conclusions beyond the current sample. Also, as only concurrent relationships between self-regulation and pretend play were investigated, we cannot make causal inferences. In fact, the observed associations between pretend play and self-regulation may have occurred because children with better self-regulation were more effective in managing and sustaining their play. Another limitation is that children's self-regulation and pretend play were observed on only one occasion, which may limit the reliability of the observational measures. Future studies should include multiple observations of children's pretend play and self-regulation in a longitudinal cross-lagged design to examine the stability of these constructs and the directionality of their relations. In addition, although the inter-rater reliability and internal consistency of the observational measures were adequate, further research is needed to evaluate the psychometric properties, including the criterion and predictive validity, of the newly developed observational measures used in this study. Also, the observation of

metacognitive knowledge might have been problematic in this study as this indicator relies heavily on the explicit verbalizing of thoughts. Although other studies have shown evidence of metacognitive knowledge in 3- to 5-year-olds, these children were involved in problem-solving tasks (e.g., Whitebread et al., 2009) that might elicit this type of behavior more strongly than a pretend play situation. Note however that, in line with previous work (Whitebread et al., 2009), the children in this study did show evidence of metacognitive strategies, which was based on both nonverbal and verbal behavioral indicators. Preferably, future studies should include different (play) situations to further investigate whether the self-regulation skills children display in the classroom depend, at least partly, on the type of play or classroom situation. Finally, post hoc power analyses revealed that the power was sufficient to detect medium or large effects (power > 0.80). However, the power to detect small effects was lower (0.50), which might explain why the positive association between cool executive functions and observed cognitive self-regulation did not reach statistical significance.

To conclude, this study adds to the existing evidence on young children's self-regulation by showing that preschoolers displayed important aspects of cognitive and emotional self-regulation in a naturalistic play setting. The present findings provide initial support that these aspects can be reliably measured in a naturalistic play situation. Furthermore, cognitive and emotional self-regulation appeared to be related but distinct constructs based on children's behavior in an actual play situation. The study also adds to the current evidence by showing that test-based measures of young children's executive functions are related to self-regulation as displayed in play. In particular, this study suggests that children's cool executive functions subserves regulation of affect-driven behavioral impulses during play. Finally, although children's displayed self-regulation reflected involvement of individual abilities, including cool executive functions, pretend play revealed substantial influence of classroom level factors. As more elaborate pretend play was substantially related to higher levels of cognitive and emotional self-regulation, the results attest to the partial situatedness of children's self-regulation. The current findings provide tentative evidence on the applicability of observational measures to investigate children's cognitive and emotional self-regulation skills in a naturalistic play situation, which can be viewed as complementary to the use of test-based measures of executive functions. The present correlational findings call for further research into the direction of effects between pretend play and children's self-regulation. Particularly, future research should be aimed at identifying teacher behaviors that can support children's self-regulation development in a classroom context.

## REFERENCES

- Belsky, J., Friedman, S. L., & Hsieh, K. H. (2001). Testing a core emotion-regulation prediction: Does early attentional persistence moderate the effect of infant negative emotionality on later development? *Child Development, 72*(1), 123–133. <https://doi.org/10.1111/1467-8624.00269>
- Berk, L. E., Mann, T. D., & Ogan, A. T. (2006). Make-believe play: Wellspring for development of self-regulation. In D. G. Singer, R. M. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: How play motivates and enhances children's cognitive and social-emotional growth* (pp. 74–100). New York: Oxford University Press.
- Bierman, K. L., Nix, R. L., Greenberg, M. T., Blair, C., & Domitrovich, C. E. (2008). Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology, 20*, 821–843. <https://doi.org/10.1017/S0954579408000394>
- Blair, C. (2002). School readiness. Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*(2), 111–127. <https://doi.org/10.1037//0003-066X.57.2.111>
- Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20*, 899–911. <https://doi.org/10.1017/S0954579408000436>
- Blair, C., & Ursache, A. (2011). A bidirectional model of executive functions and self-regulation. In R. F. Baumeister, & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (2nd ed.) (pp. 300–320). New York: Guilford.
- Blair, C., Zelazo, P. D., & Greenberg, M. T. (2005). The measurement of executive function in early childhood. *Developmental Neuropsychology, 28*, 561–571. [https://doi.org/10.1207/s15326942dn2802\\_1](https://doi.org/10.1207/s15326942dn2802_1)

- Bodrova, E., & Leong, D. J. (2006). Self-regulation as key to school readiness: How early childhood teachers promote this critical competency. In M. Zaslow, & I. Martinez-Beck (Eds.), *Critical issues in early childhood professional development* (pp. 203–224). Baltimore: Paul H. Brookes Publishing.
- Brock, L. L., Rimm-Kaufman, S. E., Nathanson, L., & Grimm, K. J. (2009). The contributions of 'hot' and 'cool' executive function to children's academic achievement, learning-related behaviors, and engagement in kindergarten. *Early Child Research Quarterly*, 24, 337–349. <https://doi.org/10.1016/j.ecresq.2009.06.001>
- Bronson, M. B. (2000). *Self-regulation in early childhood*. New York: The Guilford Press.
- Bryce, D., Whitebread, D., & Szűcs, D. (2015). The relationships among executive functions, metacognitive skills and educational achievement in 5 and 7 year-old children. *Metacognition and Learning*, 10(2), 181–198.
- Bush, G., Luu, P., & Posner, M. I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *Trends in Cognitive Sciences*, 4(6), 215–222.
- Calkins, S. D., Gill, K. L., Johnson, M. C., & Smith, C. L. (1999). Emotional reactivity and emotional regulation strategies as predictors of social behavior with peers during toddlerhood. *Social Development*, 8, 310–334. <https://doi.org/10.1111/1467-9507.00098>
- Calkins, S. D., & Williford, A. P. (2009). Taming the terrible twos: Self-regulation and school readiness. In O. A. Barbarin, & B. H. Wasik (Eds.), *Handbook of child development and early education* (pp. 172–199). New York: Guilford.
- Carlson, S. M., White, R. E., & Davis-Unger, A. C. (2014). Evidence for a relation between executive function and pretense representation in preschool children. *Cognitive Development*, 29, 1–16. <https://doi.org/10.1016/j.cogdev.2013.09.001>
- Cemore, J. J., & Herwig, J. E. (2005). Delay of gratification and make-believe play of preschoolers. *Journal of Research in Childhood Education*, 19, 251–266. <https://doi.org/10.1080/02568540509595069>
- Checa, P., & Rosario Rueda, M. (2011). Behavioral and brain measures of executive attention and school competence in late childhood. *Developmental Neuropsychology*, 36(8), 1018–1032. <https://doi.org/10.1080/87565641.2011.591857>
- Denham, S. A., Bassett, H. H., Way, E., Mincic, M., Zinsser, K., & Graling, K. (2012). Preschoolers' emotion knowledge: Self-regulatory foundations, and predictions of early school success. *Cognition & Emotion*, 26(4), 667–679.
- Denham, S. A., Warren-Khot, H. K., Hamada Bassett, H., Wyatt, T., & Perna, A. (2012). Factor structure of self-regulation in preschoolers: Testing models of a field-based assessment for early school readiness. *Journal of Experimental Child Psychology*, 111, 386–404. <https://doi.org/10.1016/j.jecp.2011.10.002>
- Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4–12 years old. *Science*, 333, 959–964. <https://doi.org/10.1126/science.1204529>
- Diamond, A., Prevor, M. B., Callender, G., & Druin, D. P. (1997). Prefrontal cortex cognitive deficits in children treated early and continuously for PKU. *Monographs of the Society for Research in Child Development*, 62(4). <https://doi.org/10.2307/1166208>
- Downer, J. T., Booren, L. M., Lima, O. K., Luckner, A. E., & Pianta, R. C. (2010). The Individualized Classroom Assessment Scoring System (inCLASS): Preliminary reliability and validity of a system for observing preschoolers' competence in classroom interactions. *Early Child Research Quarterly*, 25, 1–16. <https://doi.org/10.1016/j.ecresq.2009.08.004>
- Dunn, M., Dunn, L. M., & Schlichting, L. (2005). *Peabody Picture Vocabulary Test-III-NL*. Amsterdam: Harcourt Test Publishers.
- Egeland, B., Erickson, M. F., Clemenham-Moon, J., Hiester, M. K., & Korfmacher, J. (1990). *24 months tools coding manual: Project STEEP—Revised 1990 from Mother-Child Project scales*. Minneapolis, MI: University of Minnesota, Institute of Child Development.
- Eisenberg, N., & Spinrad, T. L. (2004). Emotion-related regulation: Sharpening the definition. *Child Development*, 75, 334–339. <https://doi.org/10.1111/j.1467-8624.2004.00674.x>
- Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M., Cumberland, A., Shepard, S. A., ... Murphy, B. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development*, 75, 25–46. <https://doi.org/10.1111/j.1467-8624.2004.00652.x>
- Eisenberg, N., & Sulik, M. J. (2012). Emotion-related self-regulation in children. *Teaching of Psychology*, 39, 77–83. <https://doi.org/10.1177/0098628311430172>
- Elias, C. L., & Berk, L. E. (2002). Self-regulation in young children: Is there a role for sociodramatic play? *Early Child Research Quarterly*, 17, 216–231. [https://doi.org/10.1016/S0885-2006\(02\)00146-1](https://doi.org/10.1016/S0885-2006(02)00146-1)
- Enders, C. K. (2010). *Applied missing data analysis*. New York, NY: Guilford Press.
- Fantuzzo, J. W., Bulotsky-Shearer, R., Frye, D., McDermott, P. A., McWayne, C., & Perlman, S. (2007). Investigation of social, emotional, and behavioral dimensions of school readiness for low-income, urban preschool children. *School Psychology Review*, 36(1), 44–62.

- Fantuzzo, J. W., Bulotsky-Shearer, R., Fusco, R. A., & McWayne, C. (2005). An investigation of preschool emotional and behavioral adjustment problems and social-emotional school readiness competencies. *Early Child Research Quarterly*, 20(3), 259–275.
- Fitzpatrick, C., & Pagani, L. S. (2012). Toddler working memory skills predict kindergarten school readiness. *Intelligence*, 40, 205–212. <https://doi.org/10.1016/j.intell.2011.11.007>
- Frahsek, S., Mack, W., Mack, C., Pflaz-Blezinger, C., & Knopf, M. (2010). Assessing different aspects of pretend play within a play setting: Towards a standardized assessment of pretend play in young children. *British Journal of Developmental Psychology*, 28, 331–345. <https://doi.org/10.1348/026151009X13666>
- Fuhs, M. W., & Day, J. D. (2011). Verbal ability and executive functioning development in preschoolers at head start. *Developmental Psychology*, 47, 404–416. <https://doi.org/10.1037/a0021065>
- Galyer, K. T., & Evans, J. M. (2001). Pretend play and the development of emotion regulation in preschool children. *Early Child Development and Care*, 166, 93–108. <https://doi.org/10.1080/0300443011660108>
- Gerhardstein, P., & Rovee-Collier, C. (2002). The development of visual search in infants and very young children. *Journal of Experimental Child Psychology*, 81(2), 194–215. <https://doi.org/10.1006/jecp.2001.2649>
- Gilpin, A. T., Brown, M. M., & Pierucci, J. M. (2015). Relations between fantasy orientation and emotion regulation in preschool. *Early Education and Development*, 26(7), 920–932. <https://doi.org/10.1080/10409289.2015.1000716>
- Göncü, A. (1993). Development of intersubjectivity in the dyadic play of preschoolers. *Early Child Research Quarterly*, 8, 99–116.
- Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation in children's early academic success. *Journal of School Psychology*, 45(1), 3–19. <https://doi.org/10.1016/j.jsp.2006.09.002>
- de Haan, D., & Singer, E. (2003). 'Use your words': A sociocultural approach to the teacher's role in the transition from physical to verbal strategies of resolving peer conflicts among toddlers. *Journal of Early Childhood Research*, 1, 95–109. <https://doi.org/10.1177/1476718X030011001>
- de Haan, D., & Singer, E. (2010). The relationship between young children's linguistic ability, home language, and their adaptive modifying strategies in peer conflicts. *First Language*, 30, 421–439. <https://doi.org/10.1177/0142723710370546>
- Hoffmann, J., & Russ, S. (2012). Pretend play, creativity, and emotion regulation in children. *Psychology of Aesthetics, Creativity, and the Arts*, 6(2), 175–184. <https://doi.org/10.1037/a0026299>
- Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16, 174–180. <https://doi.org/10.1016/j.tics.2012.01.006>
- Hox, J. J. (2010). *Multilevel analysis. Techniques and applications* (2nd ed.). New York: Routledge.
- Hudson, A., & Jacques, S. (2014). Put on a happy face! Inhibitory control and socioemotional knowledge predict emotion regulation in 5- to 7-year olds. *Journal of Experimental Child Psychology*, 123, 36–52. <https://doi.org/10.1016/j.jecp.2014.01.012>
- Kelly, R., & Hammond, S. (2011). The relationship between symbolic play and executive function in young children. *Australasian Journal of Early Childhood*, 36(2), 21.
- Kenny, D. A., Kaniskan, B., & McCoach, D. B. (2014). The performance of RMSEA in models with small degrees of freedom. *Sociological Methods & Research*, 0049124114543236.
- Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York: Guilford Press.
- Kochanska, G., Murray, K., & Coy, K. C. (1997). Inhibitory control as a contributor to conscience in childhood: From toddler to early school age. *Child Development*, 68(2), 263–277. <https://doi.org/10.1111/j.1467-8624.1997.tb01939.x>
- Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, 36(2), 220–232. <https://doi.org/10.1037//0012-1649.36.2.220>
- Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandergeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development*, 67(2), 490–507. <https://doi.org/10.1111/j.1467-8624.1996.tb01747.x>
- Kopp, C. B. (1982). Antecedents of self-regulation: A developmental perspective. *Developmental Psychology*, 18, 199–214.
- Leerkes, E. M., Paradise, M. J., O'Brien, M., Calkins, S. D., & Lange, G. (2008). Emotion and cognition processes in preschool children. *Merrill-Palmer Quarterly*, 54(1), 102–124.
- Lewis, V., Boucher, J., Lupton, L., & Watson, S. (2000). Relationships between symbolic play, functional play, verbal and non-verbal ability in young children. *International Journal of Language and Communication Disorders*, 35, 117–127. <https://doi.org/10.1080/136828200247287>

- Liebermann, D., Giesbrecht, G. F., & Müller, U. (2007). Cognitive and emotional aspects of self-regulation in preschoolers. *Cognitive Development, 22*, 511–529.
- Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives, 6*(2), 105–111. <https://doi.org/10.1111/j.1750-8606.2011.00196.x>
- Lindsey, E. W., & Colwell, M. J. (2003). Preschoolers' emotional competence: Links to pretend play and physical play. *Child Study Journal, 33*, 39–52.
- Luria, A. R. (1959). The directive function of speech in development and dissolution: I. Development of the directive function of speech in early childhood. *Word, 1*, 453–465.
- Martins, E. C., Osório, A., Veríssimo, M., & Martins, C. (2014). Emotion understanding in preschool children: The role of executive functions. *International Journal of Behavioral Development, 40*(1), 1–10. 0165025414556096.
- Matthews, S. B. (2008). The relationship among self-regulation, sociodramatic play, and preschoolers' readiness for kindergarten. *Counseling Psychology Dissertations*. Paper 8. <http://hdl.handle.net/2047/d10017045>
- McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Child Research Quarterly, 21*, 471–490. <https://doi.org/10.1016/j.ecresq.2006.09.003>
- McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives, 6*, 136–142. <https://doi.org/10.1111/j.1750-8606.2011.00191.x>.
- McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*, 947–959. <https://doi.org/10.1037/0012-1649.43.4.947>
- McClelland, M. M., Cameron, C. E., Wanless, S. B., Murray, A., Saracho, O. N., & Spodek, B. (2007). Executive function, behavioral self-regulation, and social-emotional competence. *Contemporary Perspectives on Social Learning in Early Childhood Education, 1*, 113–137.
- McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Child Research Quarterly, 15*, 307–329. [https://doi.org/10.1016/S0885-2006\(00\)00069-7](https://doi.org/10.1016/S0885-2006(00)00069-7)
- McClelland, M. M., Ponitz, C. C., Messersmith, E., & Tominey, S. (2010). Self-regulation: The integration of cognition and emotion. In R. Lerner (Series Ed.) & W. Overton (Vol. Ed.), *Handbook of life-span development* (pp. 509–553). Hoboken, NJ: Wiley & Sons.
- Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49–100. <https://doi.org/10.1006/cogp.1999.0734>
- Morrison, F. J., Ponitz, C. C., & McClelland, M. M. (2010). Self-regulation and academic achievement in the transition to school. In M. Posner (Series Ed.) & S. Calkins & M. Bell (Vol. Eds.), *The developing brain: Development at the intersection of emotion and cognition* (pp. 203–224). Washington, D. C.: American Psychological Association.
- Mulder, H., Hoofs, H., Verhagen, J., Van der Veen, I., & Leseman, P. P. M. (2014). Psychometric properties and convergent and predictive validity of an executive function test battery for two-year-olds. *Frontiers in Psychology, 5*(733), 1–17. <https://doi.org/10.3389/fpsyg.2014.00733>.
- Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.
- Nader-Grosbois, N., & Vieillevoys, S. (2012). Variability of self-regulatory strategies in children with intellectual disability and typically developing children in pretend play situations. *Journal of Intellectual Disability Research, 56*, 140–156. <https://doi.org/10.1111/j.1365-2788.2011.01443.x>
- Oudgenoeg-Paz, O., Volman, M. J. M., & Leseman, P. P. M. (2015). Exploration as a mediator of the relation between attainment of motor mile-stones and the development of spatial cognition and spatial language. *Developmental Psychology, 51*(9), 1241–1253.
- Pelphrey, K. A., Reznick, J. S., Goldman, B. D., Sasson, N., Morrow, J., Donahoe, A., & Hodgson, K. (2004). Development of visuospatial short-term memory in the second half of the 1st year of life. *Developmental Psychology, 40*, 836–851.
- Raver, C. C., Smith Carter, J., Charles McCoy, D., Roy, A., Ursache, A., & Friedman, A. (2012). Testing models of children's self-regulation within educational contexts: Implications for measurement. *Advances in Child Development and Behavior, 42*, 245–270. <https://doi.org/10.1016/B978-0-12-394388-0.00007-1>.
- Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early Child Research Quarterly, 15*(2), 147–166.



- Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. *Developmental Psychology, 45*, 958–972. <https://doi.org/10.1037/a0015861>
- Rothbart, M. K., Ellis, L. K., & Posner, M. I. (2004). Temperament and self-regulation. *Handbook of self-regulation: Research, theory, and applications, 2*, 284–299.
- Rothbart, M. K., Sheese, B. E., & Posner, M. I. (2007). Executive attention and effortful control: Linking temperament, brain networks, and genes. *Child Development Perspectives, 1*(1), 2–7.
- Scerif, G., Cornish, K., Wilding, J., Driver, J., & Karmiloff-Smith, A. (2004). Visual search in typically developing toddlers and toddlers with fragile X or Williams syndrome. *Developmental Science, 7*(1), 116–130. <https://doi.org/10.1111/j.1467-7687.2004.00327.x>
- Slot, P. L., Leseman, P. P. M., Verhagen, J., & Mulder, H. (2015). Associations between structural quality aspects and process quality in Dutch early childhood education and care settings. *Early Childhood Research Quarterly, 33*, 64–76. <https://doi.org/10.1016/j.ecresq.2015.06.001>
- Smilansky, S., & Shefatya, L. (1990). Facilitating play. In *A medium for promoting cognitive, socio-emotional and academic development in young children*. Silver Spring, MD: PS&E Publications.
- Stambak, M., & Sinclair, H. (1993). *Pretend play among 3-year olds*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Striano, T., Tomasello, M., & Rochat, P. (2001). Social and object support for early symbolic play. *Developmental Science, 4*, 442–455.
- Tabachnik, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn and Bacon.
- Trentacosta, C. J., & Izard, C. E. (2007). Kindergarten children's emotion competence as a predictor of their academic competence in first grade. *Emotion, 7*(1), 77. <https://doi.org/10.1037/1528-3542.7.1.77>
- Valloton, C., & Ayoub, C. (2011). Use your words: The role of language in the development of toddlers' self-regulation. *Early Child Research Quarterly, 26*, 169–181. <https://doi.org/10.1016/j.ecresq.2010.09.002>
- Verba, M. (1993). Construction and sharing of meanings in pretend play. In M. Stambak, & H. Sinclair (Eds.), *Pretend play among 3-year-olds* (pp. 1–31). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.
- Verhagen, J., de Bree, E.H., Mulder, H., & Leseman, P.P.M. (2016). Effects of vocabulary and phonotactic probability on two-year-olds' nonword repetition. *Journal of Psycholinguistic Research*. <https://doi.org/10.1007/s10936-016-9448-9>
- Vicari, S., Caravale, B., Carlesimo, G. A., Casadei, A. M., & Allemand, F. (2004). Spatial working memory deficits in children at ages 3–4 who were low birth weight, preterm infants. *Neuropsychology, 18*(4), 673–678. <https://doi.org/10.1037/0894-4105.18.4.673>
- Vieillevoeye, S., & Nader-Grosbois, N. (2008). Self-regulation during pretend play in children with intellectual disability and in normally developing children. *Research in Developmental Disabilities, 29*, 256–272. <https://doi.org/10.1016/j.ridd.2007.05.003>
- Vygotsky, L. S. (1967). Play and its role in the mental development of the child. *Soviet Psychology, 5*, 6–18.
- Whitebread, D., Bingham, S., Grau, V., Pino Pasternak, D., & Sangster, C. (2007). Development of metacognition and self-regulated learning in young children: Role of collaborative and peer-assisted learning. *Journal of Cognitive Education and Psychology, 6*(3), 433–455. <https://doi.org/10.1891/194589507787382043>
- Whitebread, D., Coltman, P., Pino Pasternak, D., Sangster, C., Grau, V., Bingham, S., ... Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition Learning, 4*, 63–85. <https://doi.org/10.1007/s11409-9033-1>
- Whitebread, D., & Sullivan, L. O. (2012). Preschool children's social pretend play: Supporting the development of meta-communication, metacognition and self-regulation. *International Journal of Play, 1*, 197–213. <https://doi.org/10.1080/21594937.2012.693384>
- Willoughby, M., Kupersmidt, J., Voegler-Lee, M., & Bryant, D. (2011). Contributions of hot and cool self-regulation to preschool disruptive behaviour and academic achievement. *Developmental Neuropsychology, 36*, 162–180. <https://doi.org/10.1080/87565641.2010.549980>
- Wuensch, K. L. (2012). An introduction to path analysis. Retrieved from <http://core.ecu.edu/psyc/wuenschk/MV/SEM/Path.pdf> on 4-2-2014.

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