Attentional control and executive functioning in school-aged children: Linking self-regulation and parenting strategies

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Abstract

Good parenting strategies can shape children's neurocognitive development, yet little is known about the nature of this relation in school-aged children and whether this association shifts with age. We aimed to investigate the relation between parenting strategies observed during a home visit, and children's performance-based attentional control and executive functioning (*N* = 98, aged 4 to 8). Linear and curvilinear regression analyses showed that children of parents who were more supportive, less intrusive, and who asked more open-ended questions, displayed better inhibitory control. In addition, children of parents who asked relatively more open-ended than closed-ended questions showed better performance on inhibition, working memory and cognitive flexibility tasks. Curvilinear relations indicated the presence of an optimal amount of closed-ended and elaborative questions by parents, i.e. not too few and not too many, which is linked to increased performance on attentional and inhibitory control in children. Higher parental intrusiveness and more frequent elaborative questioning were associated with decreased inhibitory control in younger children, whereas no such negative associations were present in older children. These results suggest that susceptibility to certain parenting strategies may shift with age. Our findings underscore the importance of adaptive parenting strategies to both the age and needs of school-aged children, which may positively affect their self-regulation skills.

Key words: attentional control, executive functioning, supportive presence, intrusiveness, verbal scaffolding

As children grow up, executive functions (EF) and attentional control (AC) become increasingly important for children’s successful navigation in their educational environment and daily functioning at home (Best, Miller, & Jones, 2009; Diamond, 2013; Garon, Bryson, & Smith, 2008). Executive functions are adaptive effortful mental processes that enable us to plan, guide and control goal-oriented behavior and are especially critical when solving novel problems (Best et al., 2009; Garon et al., 2008). There is general agreement that three core EF can be defined, namely inhibition, working memory and cognitive flexibility (e.g. Miyake et al., 2000). Miyake et al. (2000) argued that these three EF components share a common underlying mechanism, often referred to as effortful attentional control (AC) (Garon et al., 2008). AC is tightly intertwined with EF, both as a foundation on which EF components build and as an ongoing process playing an important role during EF development (Garon et al., 2008).

Inhibitory control is commonly described as the ability to suppress a dominant or automatic response (Best et al., 2009; Diamond, 2013). Inhibitory control is often studied in congruence with this definition of response inhibition, but it also encompasses an attentional component known as interference control: the ability to selectively attend to certain stimuli and ignore irrelevant stimuli (Diamond, 2013). Inhibitory control shows a rapid development during the preschool years, but also improves between ages five and eight (Best et al., 2009). Working memory (WM) refers to the ability to temporarily hold, manipulate and control information in the mind (Garon et al., 2008). WM is commonly subdivided by content and conceptualized as verbal WM and visual-spatial WM (Diamond, 2013). WM emerges during the preschool years and shows a linear development between ages four and fifteen, though the development of visual-spatial WM seems to reach its peak around age eleven (Best et al., 2009; Davidson, Amso, Anderson, & Diamond, 2006). The final core EF component is cognitive flexibility, the ability to shift between mental sets or tasks and adapt to changing situations (Best et al., 2009). Cognitive flexibility builds on both WM and inhibition, and shows a longer developmental trajectory, at least until early adolescence (Davidson et al., 2006). Research on AC differentiates between focused and sustained attention as underlying processes. Focused attention refers to being able to actively focus on one thing without being distracted by other stimuli and sustained attention can be defined as the ability to maintain concentrated attention over prolonged periods of time (Cohen, 2014). Early AC development peaks during the preschool years, though continues to develop during the primary school period, alongside the emergence of the core EF components (Garon et al., 2008).

The development of AC and EF in children is influenced by their relationship with their significant caregivers and the conditions in their environment (Diamond, 2013; Yu & Smith, 2016). This is not a novel insight, as Vygotsky (1978) posed nearly 40 years ago that social interaction is essential to the development of self-regulation, as did Kopp (1982) and Calkins (1994) in the decades that followed. Building on Vygotsky's work, Sigel's model of psychological distancing (2002) incorporates how parents can promote the development of self-regulation in children. Sigel states that parents can help children to take a step back during problem-solving and reflect upon the problem at hand (i.e. create psychological distance) by nonverbal or verbal actions such as asking questions (Giesbrecht, Muller, & Miller, 2010). For instance, asking questions to focus the child's attention on important aspects of the problem that the child was not yet able to notice on its own, will challenge the child's mental representations and will facilitate internalization of self-regulatory skills. Studies on quality of parenting in relation to child AC and EF have focused on four dimensions of parenting: (i) sensitivity; (ii) scaffolding; (iii) stimulation; and (iv) control (Fay-Stammbach, Hawes, & Meredith, 2014). The majority of these studies focus on parent-child interactions during infancy and the preschool years (e.g., Blair, Raver, & Berry, 2014; Clark & Woodward, 2015; Fay-Stammbach et al., 2014; Kok et al., 2013; Meuwissen &

Carlson, 2015; Mileva-Seitz et al., 2015; Rochette & Bernier, 2016; Yu & Smith, 2016). The current study addresses an older age group of 4- to 8-year-olds and focuses on aspects of (i) sensitivity and (ii) verbal scaffolding in relation to child AC and EF.

Sensitivity refers to the parents' ability to perceive and adequately respond to their child's signals. Aspects of parental sensitivity include supportive presence, referring to affective and supportive caregiving, and intrusiveness or lack of autonomy support, referring to negative and controlling parenting behaviors interfering with the child's autonomy (Dotterer, Iruka, & Pungello, 2012). Parental sensitivity has been linked to child EF (e.g., Blair et al., 2011; Kok et al., 2013; NICHD Early Child Care Research Network, 2005; Rhoades, Greenberg, Lanza, & Blair, 2011), though studies focusing on supportive presence and intrusiveness specifically, show inconclusive results. In some studies maternal support predicted child EF task battery composite scores, while intrusiveness was not investigated (e.g., Kraybill & Bell, 2013; Sulik et al., 2015). In other studies supportive presence was not associated with child EF composite scores, but intrusiveness was (Clark & Woodward, 2015; Holochwost, 2013, as cited in Fay-Stammbach et al., 2014). Bernier and colleagues (2010) also concluded that especially autonomy support (i.e. low intrusiveness) was most robustly associated with child EF. In another study, intrusiveness was also negatively related to an EF composite score at 36 months of age, but this finding was not observed at 24 months (Cuevas et al., 2014), suggesting that the effect of parental intrusiveness on child EF might be moderated by age. Associations between aspects of parental sensitivity and child AC also show inconclusive results. While Gaertner and colleagues (2008) concluded that parental support is associated with increased AC in 2 and 3 year-olds, a recent study showed that increased parental intrusiveness was associated with lower levels of AC in 4 to 5 year-olds, while no relation was found for parental supportive presence (Mathis & Bierman, 2015). This finding, though based on younger children than the current sample, also suggests that age may moderate the association between parental support and child AC.

Scaffolding can be used by caregivers to provide structure to enable the child to gain control over his cognitive performance and behavior, basically helping the child to engage in a complex task, either verbally (e.g. asking questions) or non-verbally (e.g., attention redirection behaviors) (Lewis & Carpendale, 2009). Aspects of verbal scaffolding quality have been found to be positively related to preschoolers' EF skills in general (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012), and to AC and EF components specifically. Several longitudinal studies have demonstrated that scaffolding quality predicts WM and cognitive flexibility (Bernier, Carlson, & Whipple, 2010; Conway & Stifter, 2012; Hughes & Ensor, 2009; Matte-Gagné & Bernier, 2011), while in cross-sectional studies scaffolding has been observed to be related to enhanced AC, inhibitory control and cognitive flexibility (Bibok, Carpendale, & Müller, 2009; Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013; Mendive, Bornstein, & Sebastián, 2013). This study focuses on verbal scaffolding aspects.

Verbal scaffolding can be subdivided into directive (i.e. telling the child what to do) versus elaborative verbalizations (i.e. comment on the child's own course of action), in which directive verbalizations leave little room for the child to reflect on the problem on his own, while elaborative verbalizations evoke self-guided exploration and conceptual thinking, allowing the child to practice self-regulatory skills such as EF (Bibok et al., 2009; Bonawitz et al., 2011). Self-guided exploration without adequate guidance is not effective (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011; Kirschner, Sweller, & Clark, 2006; Mayer, 2004). A specific scaffolding strategy to enhance self-guided exploration is the use of open-ended and metacognitive questioning when asking for explanations, such as "Why do you think that?" (Hmelo-Silver & Barrows, 2006). Indeed, it has been shown that parents who are less directive and who instead ask more questions and engage their child in problem-solving discussions may enhance the development of self-regulation in preschoolers (Eisenberg et al., 2010; Mathis & Bierman, 2015; Neitzel & Stright, 2003). For instance, Landry and colleagues (2000) showed that up to toddlerhood, parental directiveness had a positive effect on cognitive development, but that this effect reversed after age four, in line with their child's diminished need for structure. In contrast, elaborative parental utterances have been found to predict child EF independent of age (Bibok et al., 2009; Landry et al., 2000; Smith, Landry, & Swank, 2000), suggesting that parents should reduce directive scaffolding in favor of elaborative scaffolding when their child becomes more independent.

At different developmental stages, children need customized stimulation and guidance adapted to the situation, their needs, and the task at hand (Bradley, Pennar, & Iida, 2015). A recent study in 4- to 11-year-olds demonstrated that the relationship between parenting behaviors and child agency shifts with age (Bradley et al., 2015), in line with the findings of Landry and colleagues (2000), Cuevas and colleagues (2014), and Mathis and Bierman (2015). Since AC and EF skills are considered crucial in goal-directed behavior (Giesbrecht et al., 2010) and rapid improvements in AC and EF skills occur between the ages four and eight (Best & Miller, 2010), this raises the question whether key aspects of parenting strategies are related to AC and EF, and to what extent age moderates this relationship in 4- to 8-year-olds.

In the current study, we aim to investigate whether parental supportive presence and intrusiveness and aspects of verbal scaffolding are associated with child AC and EF skills during the early school years and to what extent age moderates these relations. We hypothesize that supportive and non-intrusive parents have children who show better AC and EF skills. As both self-guided exploration without adequate guidance and too much directiveness are not expected to be effective in stimulating self-regulation, we assume that the relation of AC and EF with level of parental intrusiveness and the amount of closed-ended questions parents ask, will be curvilinear. Furthermore, we hypothesize that in older children AC and EF are more negatively associated with higher levels of intrusiveness and more closed-ended questions. In addition, it is hypothesized that parents who are supportive and who scaffold the interaction with their child by asking more open-ended and elaborative questions, have children who show better AC and EF skills.

Method

Participants

The current study is embedded within the *xxx* program: a longitudinal program investigating the development of executive and social functioning in primary school children in the Netherlands and the effects of a parent and a teacher intervention program (approved by the Ethical Board of the department of *xxx* at *xxx* (ECPW-2010016)). The *xxx* Consortium is a collaboration of seven Dutch and Flemish research institutes studying the development of science and technology reasoning skills and exploratory behavior in children in the context of excellent learning environments (Van Geert, 2011).

Parents of 138 4- to 8-year-old children from the lowest four grades of two Dutch primary schools (pre-school to second grade in USA school system), from towns that are part of the urban agglomeration of Rotterdam and the conurbation of The Hague, agreed to participate in this study, and signed an informed consent letter. The current study used child computer-based neurocognitive measures of AC and EF and observational data of parents' interactive behavior with their child collected during a home visit. Parents of 99 out of 138 children agreed to a home visit (response = 71.7%, 10.1% fathers). Participants who agreed to a home visit did not significantly (all $p > .05$) differ on age, gender, school, grade, single parenthood status, parental education or prevalence of referral to mental health care in the past year from those who did not agree to a home visit. One child refused to complete the neurocognitive assessments and was excluded from analyses (Final $N = 98$). Children ranged in age from 4 to 8 years (M = 6.2 years, SD = 1.2) and 56.1% were male. No parents or children were excluded because of problems with oral or written proficiency in Dutch. For detailed sample characteristics, see Table 1.

Procedure

Computer-based performance tasks were administered during an individual test session (approximately 60 minutes) in a separate room at the child's school. Tests were administered by two trained master students or by one of the main investigators (AMS, MCD). After the session the children could choose a small present as a token of appreciation. All home visits were conducted by master student pairs. Data were collected in the period between November 2013 and February 2014 (school 1) and between May and June 2014 (school 2).

Measures

Demographic characteristics

Parents were asked to fill out a complementary background information questionnaire, using the online survey software Qualtrics (http://www.qualtrics.com/). The highest completed level of education by the parent who participated in the home visit was used as an indicator of educational attainment according to the Dutch Standard Classification of Education (SOI) which is based on UNESCO's International Standard Classification of Education (ISCED) ("SOI 2003 (Issue 2006/'07),"): 1. primary education (SOI level 1 to 3; at most vocational training); 2. Secondary education (level 4 of SOI); and higher education (level 5 to 7 of SOI; bachelor's degree or higher). Single parenthood status was established for the parent who participated in the home visit, and was defined by not having the child's other parent or a new caregiver living in the same household. Mental health care referral was assessed by asking, parents whether their child had been referred, examined or treated for emotional and behavioral problems in the past year.

Parenting strategies

Parent’s interactive behavior with their child was videotaped during a home visit, while each parent-child dyad was engaged in two joint activity tasks. These tasks consisted of a sorting task and a combining task of approximately five to ten minutes, both based on tasks designed by Utrecht University (Corvers, Feijs, Munk, & Uittenbogaard, 2012). Parent-child dyads were randomly assigned to either complete task version A (N=50, 51%) or task version B of each joint activity task (N=48, 49%), as required for other parts of the Leiden Curious Minds Research Program. Version A of the joint tasks battery consisted of sorting different types of toy animals and combining four different eyes and four different mouths to form smiley faces with various facial expressions, and version B of the joint tasks battery consisted of sorting different types of toy food and combining four different flower petals with four different disks to form unique flowers. Parent-child dyads were free to sort and combine the items according to their own strategy, as long as all combinations in the combining task were different. Parents were instructed to support their child as they would normally do. The videotapes were coded afterwards for level of parental supportive presence and intrusiveness and the amount of different types of questions asked by the parent.

Aspects of parental sensitivity. Parental supportive presence and intrusiveness were coded using the revised Erickson 7-point scale for Supportive Presence (SP) and Intrusiveness (Egeland, Erickson, Clemenhagen-Moon, Hiester, & Korfmacher, 1990). A parent scoring high on SP shows emotional support to the child and is reassuring when the child is having difficulty with the task. A parent scoring high on Intrusiveness lacks respect for the child’s autonomy and does not acknowledge the child’s intentions or desires. The subscales SP and Intrusiveness were coded for each joint activity task by three coders who were blind to other data concerning the child or the parent. For each parent-child dyad, the combining task and sorting task were coded independently and by different coders. All coders completed an extensive training, consisting of several practice and feedback sessions supervised by an expert coder. Reliability of the coders (intraclass correlation (ICC)) was assessed directly after completion of the training and at the end of the coding process to detect possible rater drift. ICCs between coders directly after training were .92 for the SP scale (*N* = 12) and .81 for the Intrusiveness scale (*N* = 12). At the end of the coding process, ICCs were .91 for the SP scale (*N* = 12) and .92 for the Intrusiveness scale (*N* = 12), suggesting no significant rater drift. Whenever interactions were difficult to score due to an ambiguous interaction (*N* = 14), consensus was sought after a discussion with all coders. Although parent-child dyads were randomly assigned to either joint task battery A or B, each task battery may have elicited a somewhat different interaction between parent and child. Therefore, level of SP and Intrusiveness was computed by standardizing each task version score (A or B) within each task (sorting or combining), followed by averaging these Z-scores over both joint activity tasks.

Aspects of parental verbal scaffolding. The form and type of questions parents asked their child during the two joint activity tasks were used as a measure of verbal scaffolding. All questions were coded from video recordings using transcribed verbatim reports. Each question was first coded as either being (i) *open-ended* (e.g., “How do you want to start?”; (ii) *multiple choice* (e.g., “Does a kangaroo live in the zoo or in the ocean?”; or (iii) *closed-ended* (e.g., “Is a cow a farm animal?”). Next, questions were coded in the following categories: (a) *observational leading questions* (e.g., “What’s the color of this food”, enquiring about observable aspects during the task); (b) *procedural questions* (e.g., “How are you going to sort the animals?”, enquiring about an action plan); and (c) *explanatory questions* (e.g., “Why can’t the toad be in the ocean group?”, enquiring about explanations for decisions). The form and category of each question was coded for both joint activity tasks by three coders who were blind to other data concerning the child or the parent and who were not involved in coding SP and Intrusiveness. All coders completed an extensive training, consisting of several practice and feedback sessions supervised by the main researcher. Interrater reliability (Cohen's kappa) was large, with .84 on average for the sorting task ($N_{questions}$ = 122) and .87 on average for the combining task ($N_{questions}$ = 115). For each question form and category within each task the number of questions per minute was calculated. Although parent-child dyads were randomly assigned to either joint task battery A or B, each task battery may have elicited a somewhat different interaction between parent and child. Therefore, we standardized the number of questions per minute within each task (sorting or combining) for each task version (A or B), followed by averaging these Z-scores over the joint activity tasks. Due to very low occurrence of multiple-choice questions (2.4%), this form was excluded from further analyses. The difference score between the standardized amounts of open- and closed-ended questions was calculated as a relative measure of question format preference during the tasks. A higher ratio score indicates that the parent asked more open-ended than closed-ended questions relative to the other parents. From now on, the term 'verbal scaffolding' will be used to address both the form and category of questions.

Self-regulation

We assessed aspects of attentional control and executive functions as measures of self-regulation with several neuropsychological tasks from the Amsterdam Neuropsychological Tasks (ANT, version 2.0), a well-validated computerized test battery (De Sonneville, 2005; 2014). The ANT has been used extensively in both clinical and non-clinical populations and contains widely used paradigms such as the Go/No-Go paradigm, with adequate test-retest stability and discriminant validity in children (Kindlon, Mezzacappa, & Earls, 1995). The ANT test battery requires a processor supporting Windows XP or higher and can be obtained via www.sonares.nl, including a demo-version. All computer tasks were preceded by instructions and practice trials.

Attentional control. Attentional control was measured with the ANT Focused Attention Objects - 2 keys (FAO2) task and the ANT Sustained Attention Objects - 2 keys (SAO2) task. Due to a ceiling effect on number of correct responses (58.8% of the children had an error rate of less than 10% on the FAO2; 49.4% on the SAO2), mean reaction time on correct responses was used to assess level of focused and sustained attention. Besides the number of correct responses, reaction time is commonly used to assess (sustained) attention (see Flehmig, Steinborn, Langner, Scholz, & Westhoff, 2007). Sarter et al. (2001) specifically suggest using reaction time as the critical measure of performance when participants show high levels of correct responses and low levels of errors. Variation in reaction time (SD) was significantly and highly correlated with mean reaction time on correct responses (r = .82 on the FAO2; r = .83 on the SAO2), resulting in a redundant measure of performance, and was therefore not included in further analyses.

Focused attention. In the FAO2 task, participants are presented with a fruit bowl on the computer screen, in which four pieces of fruit are displayed. Participants are instructed to click the mouse button on their dominant hand side (‘yes-button’) whenever they perceive the cherries (target signal) in one of the horizontal locations (at the left- or right-side of the screen). Whenever the cherries are displayed at one of the vertical locations (at the top or bottom of the screen) or when the cherries are not displayed at all, participants are instructed to click the mouse button on their non-dominant hand side (‘no-button’). In total, 28 relevant targets (hits), 14 irrelevant targets (incorrect location), and 14 non-targets (incorrect fruit) are presented. Mean reaction time on correct responses was used to assess level of focused attention.

Sustained attention. In the SAO2 task, participants are presented with a house with three windows and a doorframe on the computer screen. In each trial, an animal is displayed randomly in one of the windows or the doorframe. Participants are instructed to click the mouse button on their dominant hand side ('yes-button') whenever they see the bee (target signal). Each time a different animal is displayed, participants are instructed to click the mouse button on their non-dominant hand side ('no-button'). In total, six different targets and six different non-targets are randomly presented on screen in 20 series of 12 trials. Whenever the participant errs, an auditory feedback signal (a beep) is given in order to reestablish attention. Mean reaction time on correct responses was used to measure level of sustained attention.

Inhibitory control. Inhibitory control was measured with the ANT Go-NoGo (GNG) task and the ANT Response Organization Objects (ROO) task. As suggested by Friedman & Miyake (2004), we used multiple measures of the inhibition related process as a practical solution to issues related to task impurity and low reliability. In the GNG task, either a square with a gap (Go-signal) or without one (NoGo-signal) is presented centered on the computer screen. Participants are instructed to click the mouse button when the Go-signal is displayed, but withhold this response whenever the NoGo-signal is displayed. In total, 56 Go-signals (75%) and 18 NoGo-signals (25%) are evaluated. The number of false alarms on this task was used as a measure of level of response inhibition, as well as the number of missed Go-signals. A higher amount of false alarms (e.g. the participant clicks when the target signal is not presented) indicates that a child is less able to inhibit a prepotent response. A lower amount of missed target signals (e.g. the participant does not click when the target signal is presented) indicates better interference control (i.e. selectively attending to the target signal and ignoring irrelevant targets).

During the ROO task, a green ball (part 1) or red one (part 2) appears at the left or right side of a white fixation cross. During the first part of the task, participants are instructed to click the mouse button that corresponds to the side where the green ball is presented (compatible prepotent response). During the second part of the task, participants are instructed to click the mouse button on the opposite side of where the red ball is presented (incompatible response), inhibiting the prepotent response from part 1. Both parts consist of 40 trials each. The number of errors in part 2 was used to assess the extent to which a child is able to inhibit a prepotent response in order to give another response.

Working memory. Visual-spatial working memory was measured with the ANT Spatial Temporal Span (STS). In this task, nine squares are presented on the computer screen in a three-by-three matrix. During each trial, an incremental sequence of these squares (two up to a maximum of nine) is pointed out by a hand animation. The participant is instructed to reproduce this sequence by clicking the same squares in reversed order (part 2, backward span). In each trial the sequence is preceded by an auditory cue (a beep). In each sequence, the number of appointed squares is presented in two successive trials. The task aborts automatically whenever two successive trials of the same sequence number are incorrect (e.g., both 5-squares sequences incorrect). The number of correct sequences (maximum = 88) in identical order backwards was used to assess level of working memory.

Cognitive flexibility. Cognitive flexibility was measured with the ANT Response Organization Objects (ROO) task. During the third part of the ROO task, the color of the ball alternates randomly between green and red. Whenever the green ball appears, a compatible prepotent response is required (as in part 1), but when the red ball appears an incompatible response is required (as in part 2). This part consists of 80 trials; 40 trials requiring a compatible response and 40 trials requiring an incompatible response. The overall amount of errors in part 3 was used to measure level of cognitive flexibility.

Data analyses

Data were analyzed using IBM SPSS version 23. Demographic characteristics for both schools were compared with chi-square tests, independent t-tests and Fisher exact tests. For test variables with non-normal distributions, either square root or natural log transformations were performed prior to further analyses. Hierarchical linear regression analyses were performed to assess whether parenting strategies explained additional variance of child AC and EF above or in interaction with age. Age was centered and all aspects of parenting were standardized to z-scores. Separate regression analyses were performed for each AC and EF component (dependent variable) and each parenting strategy (independent variable). In each regression analysis the following models were tested: (i) the aspect of parenting strategy and age were included (M1); (ii) the quadratic term of the independent variable was added to test for curvilinearity (M2); (iii) the interaction term between the aspect of parenting strategy and age was added (M3); (iv) the interaction between the quadratic term of the aspect of parenting strategy with age was added (M4) (Ganzach, 1997). *F* for change in R^2 was used to assess whether a more extensive model significantly improved the amount of variance explained in comparison with the previous more parsimonious model. Predicted R^2 was computed as a cross-validation measure. A negative predicted R^2 or a sizeable difference between predicted and regular (adjusted) R^2 can be an indication of an overfit model (i.e. predicting random noise). Significant interactions were probed with regression analyses that included a conditional moderator variable (e.g., low-age: 1 *SD* below $M_{age;}$ and high-age: 1 *SD* above M_{age}) (Holmbeck, 2002). Regression lines were plotted based on the resulting regression equations and significance t-tests were reported for each simple slope. For all significant effects, standardized beta coefficients address effect size (0.2 = small effect; 0.5 = moderate effect; 0.8 = strong effect), as well as adjusted R^2 values (0.4 = small effect; .25 = moderate effect; .64 = strong effect) were reported (Ferguson, 2009). In case of a significant curvilinear effect, a positive beta coefficient corresponds with a concave association and a negative beta coefficient corresponds with a convex association. Alpha for significant effects was set at $p < .05$.

Results

Sample characteristics and descriptive statistics for the variables of interest are displayed in Table 1. Schools did not significantly differ on background characteristics of the participants. Simple correlations between all independent parenting variables and all dependent AC and EF measures and age are presented in Table 2. Verbal scaffolding, especially asking closed-ended questions, was significantly associated with AC and EF measures. In addition, supportive presence was correlated with interference control. Correlations between all AC and EF measures were in the small to moderate range, except for the two AC measures, which were more strongly related ($r = .76$). Age was significantly associated with all AC and EF measures, in the expected direction (i.e. with increasing age, AC and EF performance improved). Hierarchical regression analyses, including age, were conducted to assess the nature of the associations (e.g. curvilinearity, moderation) between parenting variables and all AC and EF measures in more depth. Results of the most parsimonious model of each hierarchical regression analysis of SP and Intrusiveness explaining AC and EF are presented in Table 3. Results concerning verbal scaffolding explaining AC and EF are presented in Table 4 (parental question format) and Table 5 (question category). The predicted R^2 value of each model was reasonably close to the corresponding adjusted R^2 value, indicating that overfitting was not an issue. Model 4, including the interaction between the quadratic term of the aspect of parenting strategy with age, was never the most parsimonious model and is thus not presented in the tables.

[INSERT TABLE 1 ABOUT HERE]

Table 1.

Participant characteristics and descriptive statistics variables of interest.

	Total (*N*=98) %	M (SD)[b]	Range[b]
Age in months (*M (SD)*)		74.30 (14.56)	49-101
Sex (male)	56.12		
Parental education[a]			
High	40.43		
Medium	52.13		
Low	7.45		
Single parenthood (%)	6.38		
Referral to mental health care past year	6.38		
Parental sensitivity			
Supportive presence		3.95 (1.46)	1.00 - 6.75
Intrusiveness		3.76 (1.42)	1.00 - 7.00
Number of questions per minute			
Closed-ended questions		2.16 (.94)	0 - 4.19
Open-ended questions		1.86 (.95)	.17 - 5.18
Observational leading questions		.64 (.48)	0 - 2.28
Procedural questions		.14 (.18)	0 - .73
Explanatory questions		.16 (.18)	0 - .89

[a]Background information was missing for *N*=4 children due to non-response on parental questionnaires. [b]Original values before transformation and standardization.

[INSERT TABLE 2 ABOUT HERE]

Table 2.

Correlations amongst observed parenting behaviors, AC and EF measures, and age.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Supportive presence	-	-.80**	.34**	.17	.15	.29**	.22*	.21*	.01	.04	-.24*	-.06	-.16	.03	.12	-.11
2. Intrusiveness		-	-.23*	-.04	-.18	-.32**	-.18	-.23*	-.08	-.05	.15	.03	.14	.08	-.07	.20*
3. Open-ended questions			-	.42**	.53**	.54**	.16	.29**	.06	.18	.05	.11	.06	-.19	.04	-.32**
4. Closed-ended questions				-	-.55**	.47**	.09	.08	.05	.24*	.23*	.10	.28*	-.38**	.26*	-.36**
5. Ratio questions					-	.06	.06	.19	.01	-.06	-.17	.01	-.21*	.19	-.21*	.05
6. Observational leading questions						-	-.06	.25*	.12	.20*	.15	.05	.09	-.21*	.07	-.32**
7. Procedural questions							-	.02	-.01	-.02	-.02	.14	-.19	.09	-.18	.06
8. Explanatory questions								-	-.08	-.06	.02	-.01	.10	-.04	-.03	-.02
9. Focused attention									-	.76**	.46**	.26*	.20*	-.45**	.19	-.51**
10. Sustained attention										-	.47**	.26*	.32**	-.44**	.22*	-.64**
11. Inhibitory control: GNG misses											-	.36**	.51**	-.65**	.23*	-.63**
12. Inhibitory control: GNG FA												-	.37**	-.40**	.21*	-.26**
13. Inhibitory control: ROO 2													-	-.58**	.53**	-.37**
14. Working memory														-	-.38**	.64**
15. Cognitive flexibility															-	-.31**
16. Age																-

Note: *$p<.05$; **$p<.01$.

Parenting strategies and AC

SP and Intrusiveness

A significant interaction effect for intrusiveness with age was found for sustained attention (β = -.17, p = .04, adjusted R^2 = .39) (See Figure 1). Post hoc probing showed that intrusiveness was only significantly associated with a longer reaction time on the sustained attention task in younger children (β = .27, p = .03, adjusted R^2 = .42). No significant association between child AC and supportive presence was found.

[INSERT FIGURE 1 ABOUT HERE]

[INSERT TABLE 3 ABOUT HERE]

Verbal scaffolding

No significant associations were found between child AC and open- or closed-ended questions, nor between child AC and leading observational questions. A significant interaction effect for procedural questions with age was found both for focused attention (β = .20, *p* = .03, adjusted R^2 =.28) and sustained attention (β = .17, *p* = .04, adjusted R^2 = .42). Post hoc probing, however, showed that amount of procedural questions was not significantly related (all $p > .05$) in either age group to the reaction time on the focused (β_{young} = -.22; β_{old} = .22) and the sustained attention task (β_{young} = -.17; β_{old} = .18). Explanatory questions showed a curvilinear relation that was positively accelerated with reaction time on the focused attention task (β = .21, *p* = .04, adjusted R^2 = .28). This convex relation indicated that children of parents who asked relatively more explanatory questions had a shorter reaction time, but only up to a certain point (inflection point = .67, <1 *SD* above the mean; see Figure 2a). Beyond the inflection point asking more explanatory questions was associated with worse focused attention task performance.

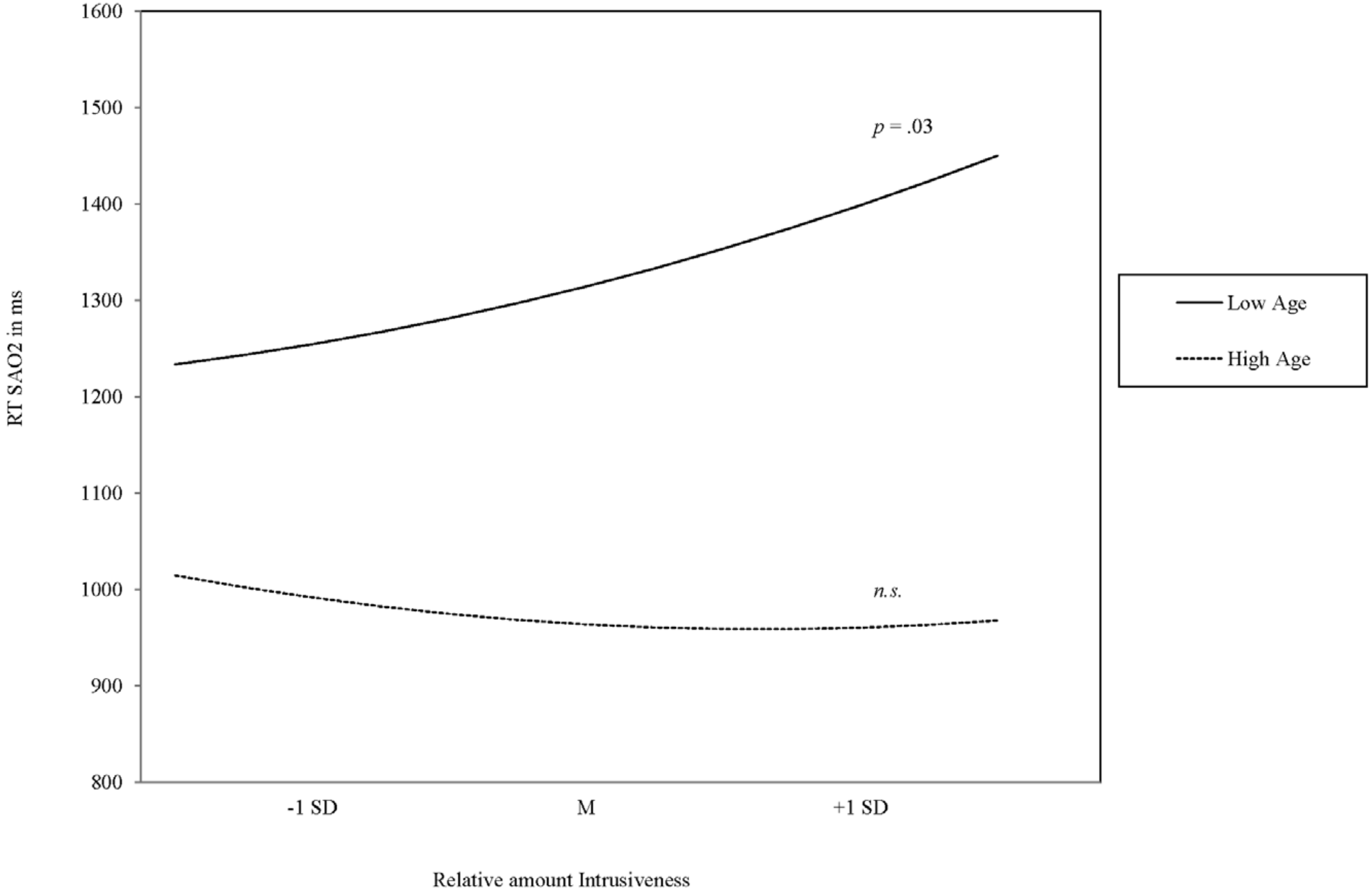

Figure 1. Moderation effect of age on the relation between parental intrusiveness and reaction time sustained attention task (RT SAO2).

Table 3. Hierarchical regression analysis results of most parsimonious models for supportive presence and intrusiveness explaining child AC and EF.

		Attentional control		Executive functions				
				Inhibitory control			Working memory	Cognitive flexibility
		Focused RT	Sustained RT	Interference control GNG misses	Prepotent GNG FA	Prepotent ROO part 2	STS	ROO part 3
Parental sensitivity		B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Supportive Presence								
Intercept		1684.53 (42.51)	1145.57 (21.37)	1.33 (.07)	2.03 (.08)	1.46 (.12)	4.15 (.17)	2.98 (.15)
M1	SP	-23.80 (45.95)	-5.10 (23.24)	-.32 (.08)***	-.08 (.09)	-.28 (.13)*	.25 (.18)	.14 (.16)
	Age	-204.80 (35.51)***	-143.83 (17.95)***	-.53 (.06)***	-.18 (.07)**	-.43 (.10)***	1.17 (.14)***	-.39 (.13)**
Adj. R^2 / *Pred.* R^2		.25 / .22	.39 / .37	.49 / .47	.06 / .03	.16 / .13	.41 / .39	.09 / .06
ΔR^2 / $F\ \Delta R^2$		.26 / 16.64***	.41 / 32.26***	.50 / 47.58***	.08 / 3.89*	.18 / 10.09***	.43 / 35.11***	.11 / 5.50**
Intrusiveness								
Intercept		1684.53 (42.56)	1141.36 (29.20)	1.33 (.07)	2.03 (.08)	1.46 (.12)	4.15 (.17)	2.98 (.15)
M1	I	13.01 (48.35)	31.94 (24.69)	.30 (.08)***	.07 (.09)	.32 (.14)*	-.14 (.19)	-.01 (.17)
	Age	-204.67 (36.05***	-145.42 (18.22)***	-.55 (.06)***	-.18 (.07)**	-.45 (.10)***	1.17 (.14)***	-.40 (.13)**
M2	I^2		15.20 (25.87)					
M3	I x Age		-40.72 (19.93)*					
Adj. R^2 / *Pred.* R^2		.24 / .22	.41 / .39	.47 / .45	.05 / .03	.17 / .13	.41 / .38	.08 / .05
ΔR^2 / $F\ \Delta R^2$		.26 / 16.51***	.03 / 4.17*	.48 / 43.92***	.07 / 3.78*	.18 / 10.54***	.42 / 33.97***	.10 / 5.09**

Note: M1: first model with linear independent variable and age; M2: second model adding quadratic independent variable; M3: third model adding linear interaction. Variables marked with superscript 2s are curvilinear variables. Adjusted R^2 and predicted R^2 of the most parsimonious model are reported. ΔR^2: Change in R^2 in comparison with the previous model. $F\ \Delta R^2$: *F* for change in R^2 in comparison with the previous model, with *p<.05; **p<.01; ***p<.0001.

Table 4. Hierarchical regression analysis results of most parsimonious models for question format explaining child AC and EF.

		Attentional control		Executive functions				
				Inhibitory control			Working memory	Cognitive flexibility
		Focused RT	Sustained RT	Interference control GNG misses	Prepotent GNG FA	Prepotent ROO part 2	STS	ROO part 3
Parental scaffolding		B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Closed questions								
Intercept		1681.88 (42.03)	1145.86 (21.38)	1.21 (.09)	1.90 (.09)	1.25 (.15)	4.14 (.17)	2.99 (.15)
M1	Closed	-85.10 (52.93)	6.76 (27.07)	<-.01 (.10)	.01 (.10)	.26 (.16)	-.44 (.21)*	.30 (.19)
	Age	-223.87 (37.26)***	-141.83 (19.01)***	-.50(.07)***	-.17 (.07)*	-.34 (.11)**	1.04 (.15)***	-.33 (.13)*
M2	Closed^2			.16 (.07)*	.18 (.07)*	.30 (.11)**		
Adj. R^2 / *Pred.* R^2		.26 / .23	.40 / .37	.42 / .39	.10 / .05	.20 / .17	.43 / .41	.10 / .08
ΔR^2 / $F\ \Delta R^2$		.28 / 18.21***	.41 / 32.27***	.03 / 5.70*	.06 / 6.62*	.06 / 7.25**	.44 / 37.34***	.12 / 6.51**
Open questions								
Intercept		1684.18 (42.23)	1145.52 (21.36)	1.33 (.07)	2.03 (.08)	1.46 (.13)	4.15 (.17)	2.98 (.15)
M1	Open	-66.12 (53.28)	-8.03 (26.83)	-.20 (.09)*	.03 (.10)	-.11 (.16)	.05 (.21)	-.13 (.19)
	Age	-217.61 (37.04)***	-145.22 (18.81)***	-.55 (.07)***	-.16 (.07)*	-.43 (.11)***	1.16 (.15)***	-.43 (.13)**
Adj. R^2 / *Pred.* R^2		.26 / .23	.40 / .37	.42 / .40	.05 / .03	.12 / .09	.40 / .38	.08 / .05
ΔR^2 / $F\ \Delta R^2$		.27 / 17.50***	.41 / 32.30***	.43 / 35.65***	.07 / 3.48*	.14 / 7.72**	.41 / 33.59***	.10 / 5.34**
Ratio open-closed								
Intercept		1684.17 (42.57)	1145.87 (21.35)	1.33 (.07)	2.03 (.08)	1.47 (.12)	4.15 (.17)	2.99 (.15)
M1	Ratio	14.91 (47.36)	-.11.36 (23.59)	-.15 (.08)	.02 (.09)	-.29 (.14)*	.37 (.18)*	-.34 (.17)*
	Age	-203.07 (35.33)***	-143.23 (17.85)***	-.50 (.06)***	-.17 (.07)*	-.40 (.10)***	1.13 (.14)***	-.40 (.12)**
Adj. R^2 / *Pred.* R^2		.24 / .21	.40 / .37	.41 / .39	.05 / .02	.16 / .12	.43 / .41	.12 / .08
ΔR^2 / $F\ \Delta R^2$		.26 / 16.53***	.41 / 32.42***	.42 / 34.69***	.07 / 3.45*	.18 / 10.02***	.44 / 37.11***	.14 / 7.39**

Note: M1: first model with linear independent variable and age; M2: second model adding quadratic independent variable. Variables marked with superscript 2s are curvilinear variables. Adjusted R^2 and predicted R^2 of the most parsimonious model are reported. ΔR^2: Change in R^2 in comparison with the previous model. $F\ \Delta R^2$: F for change in R^2 in comparison with the previous model, with *p<.05; **p<.01; ***p<.0001.

Table 5. Hierarchical regression analysis results of most parsimonious models for question category explaining child AC and EF.

		Attentional control		**Executive functions**				
				Inhibitory control			**Working memory**	**Cognitive flexibility**
		Focused RT	Sustained RT	Interference control GNG misses	Prepotent GNG FA	Prepotent ROO part 2	STS	ROO part 3
Parental scaffolding		B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Leading observational questions								
Intercept		1684.44 (42.51)	1145.62 (21.37)	1.20 (.10)	2.03 (.08)	1.46 (.13)	4.15 (.17)	3.25 (.20)
M1	Obs.	-29.50 (56.70)	-1.61 (28.46)	-.06 (.10)	-.04 (.11)	-.05 (.17)	-.02 (.23)	-.10 (.20)
	Age	-208.83 (37.18)***	-143.79***	-.55 (.07)***	-.18 (.07)*	-.42 (.11)***	1.14 (.15)***	-.35 (.14)*
M2	Obs.^{2}			.22 (.10)*				-.44 (.20)*
Adj. R^2 / Pred. R^2		.25 / .22	.39 / .37	.42 / .39	.05 / .03	.12 / .09	.40 / .38	.11 / .09
ΔR^2 / $F \Delta R^2$		.26 / 16.64***	.41 / 32.23***	.03 / 4.47*	.07 / 3.50*	.14 / 7.51**	.41 / 33.55***	.04 / 4.61*
Procedural questions								
Intercept		1656.95 (53.86)	1134.90 (27.22)	1.33 (.08)	2.03 (.08)	1.46 (.12)	4.15 (.17)	2.98 (.15)
M1	Proc.	-15.90 (61.69)	-3.57 (31.27)	.02 (.10)	.15 (.10)	-.27 (.16)	.13 (.22)	-.32 (.20)
	Age	-194.47 (35.29)***	-139.18 (17.89)***	-.50 (.06)***	-.18 (.07)**	-.39 (.10)***	1.14 (.14)***	-.39 (.13)**
M2	Proc.^{2}	32.87 (60.06)	11.82 (29.06)					
M3	Proc. x Age	103.61 (48.62)*	47.01 (23.61)*					
Adj. R^2 / Pred. R^2		.28 / .26	.42 / .39	.39 / .37	.07 / .05	.14 / .11	.40 / .38	.10 / .07
ΔR^2 / $F \Delta R^2$		.03 / 4.54*	.02 / 3.96*	.40 / 32.00***	.09 / 4.70*	.16 / 9.01***	.42 / 33.87***	.12 / 6.52**
Explanatory questions								
Intercept		1610.55 (54.92)	1145.28 (21.35)	1.33 (.08)	2.06 (.10)	1.46 (.13)	4.15 (.17)	2.98 (.15)
M1	Exp.	-134.56 (64.85)*	-15.94 (29.15)	<.01 (.10)	.04 (.12)	.16 (.17)	-.08 (.22)	-.09 (.20)
	Age	-209.48 (34.61)***	-143.22 (17.85)***	-.50 (.06)***	-.20 (.06)**	-.40 (.10)***	1.15 (.14)***	-.41 (.13)**
M2	Exp.^{2}	132.40 (63.65)*			-.06 (.12)			
M3	Exp. x Age				-.26 (.09)**			
Adj. R^2 / Pred. R^2		.28 / .24	.40 / .37	.39 / .37	.11 / .08	.13 / .10	.40 / .38	.08 / .05
ΔR^2 / $F \Delta R^2$		.03 / 4.44*	.41 / 32.47***	.40 / 31.98***	.08 / 8.87**	.15 / 7.96**	.42 / 33.66***	.10 / 5.20**

Note: M1: first model with linear independent variable and age; M2: second model adding quadratic independent variable; M3: third model adding linear interaction. Variables marked with superscript 2s are curvilinear variables. Adjusted R^2 and predicted R^2 of the most parsimonious model are reported. ΔR^2: Change in R^2 in comparison with the previous model. $F \Delta R^2$: F for change in R^2 in comparison with the previous model, with *p<.05; **p<.01; ***p<.0001.

[INSERT TABLE 4 ABOUT HERE]

[INSERT TABLE 5 ABOUT HERE]

Parenting strategies and EF

SP and Intrusiveness

Higher supportive presence was associated with fewer misses on the GNG task (β = -.32, p <.001, adjusted R^2 = .49) and fewer errors on the ROO-2 task (β = -.20, p = .04, adjusted R^2 = .16), both tasks assessing aspects of inhibitory control. Higher intrusiveness was related to more misses on the GNG inhibition task (β = .29, p <.001, adjusted R^2 = .47) and more errors on the ROO-2 inhibition task (β = .22, p = .02, adjusted R^2 = .17) too. No significant association of parental support and intrusiveness with working memory or with cognitive flexibility was found.

Verbal scaffolding

The relative amount of closed-ended questions asked by parents had a positively accelerated curvilinear relation with number of false alarms (β = .26, p = .01, adjusted R^2 = .10) and number of misses (β = .20, p = .02, adjusted R^2 = .42) on the GNG task, as well as with number of errors on the ROO-2 task (β = .26, p <.01, adjusted R^2 = .20), all assessing inhibitory control. These convex relations indicate that initially, parents who ask relatively more closed-ended questions have children who do better on these inhibition tasks, but only until a certain point. After this inflection point, asking more closed-ended questions is increasingly associated with inhibition errors (both GNG inflection points = .19, <1 *SD* above the mean; ROO inflection point = -.25, <1 *SD* below the mean; see Figure 2b). In addition, children of parents who asked more closed-ended questions identified fewer targets on the working memory task (β = -.17, p = .04, adjusted R^2 = .43). Asking more open-ended questions was linked to fewer misses on the GNG inhibition task (β = -.17, *p* = .04, adjusted R^2 = .42). Furthermore, a higher open- versus closed-ended questions ratio score was associated with fewer errors on the ROO-2 task (β = -.20, *p* = .04, adjusted R^2 = .16), assessing inhibitory control, and on the ROO-3 task (β = -.20, *p* = .04, adjusted R^2 = .12), assessing cognitive flexibility. In addition, children of parents with a higher open versus closed-ended questions ratio score identified more targets on the working memory task (β = .16, *p* = .04, adjusted R^2 = .43).

Observational leading questions showed a curvilinear relation that was positively accelerated with number of misses on the GNG inhibition task (β = .17, *p* = .04, adjusted R^2 = .42), and that was negatively accelerated with number of errors on the ROO-3 flexibility task (β = -.22, *p* = .03, adjusted R^2 = .11) (see Figure 2c). The convex relation with number of misses on the GNG indicated that more observational leading questions were associated with fewer inhibitory control errors, but once the amount of questions reached a higher level (inflection point = .20, <1 *SD* above the mean), children of parents who asked relatively more observational leading questions had more misses. In contrast, the concave relation with cognitive flexibility indicated that more observational leading questions were associated with increasingly fewer errors as the relative amount of questions reached a certain point (inflection point = -.21, <1 *SD* below the mean; see Figure 2c). In addition, a significant interaction effect for explanatory questions with age was found for the number of false alarms on the GNG inhibition task (β = -.30, *p* <.01, adjusted R^2 = .11) (See Figure 2d). Post hoc probing showed that amount of explanatory questions was associated with more false alarms in younger children (β = .29, *p*= .03, adjusted R^2 = .12), but with fewer false alarms in older children (β = -.28, *p* = .03, adjusted R^2 = .12). No significant association between question category and working memory was found.

[INSERT FIGURE 2 ABOUT HERE]

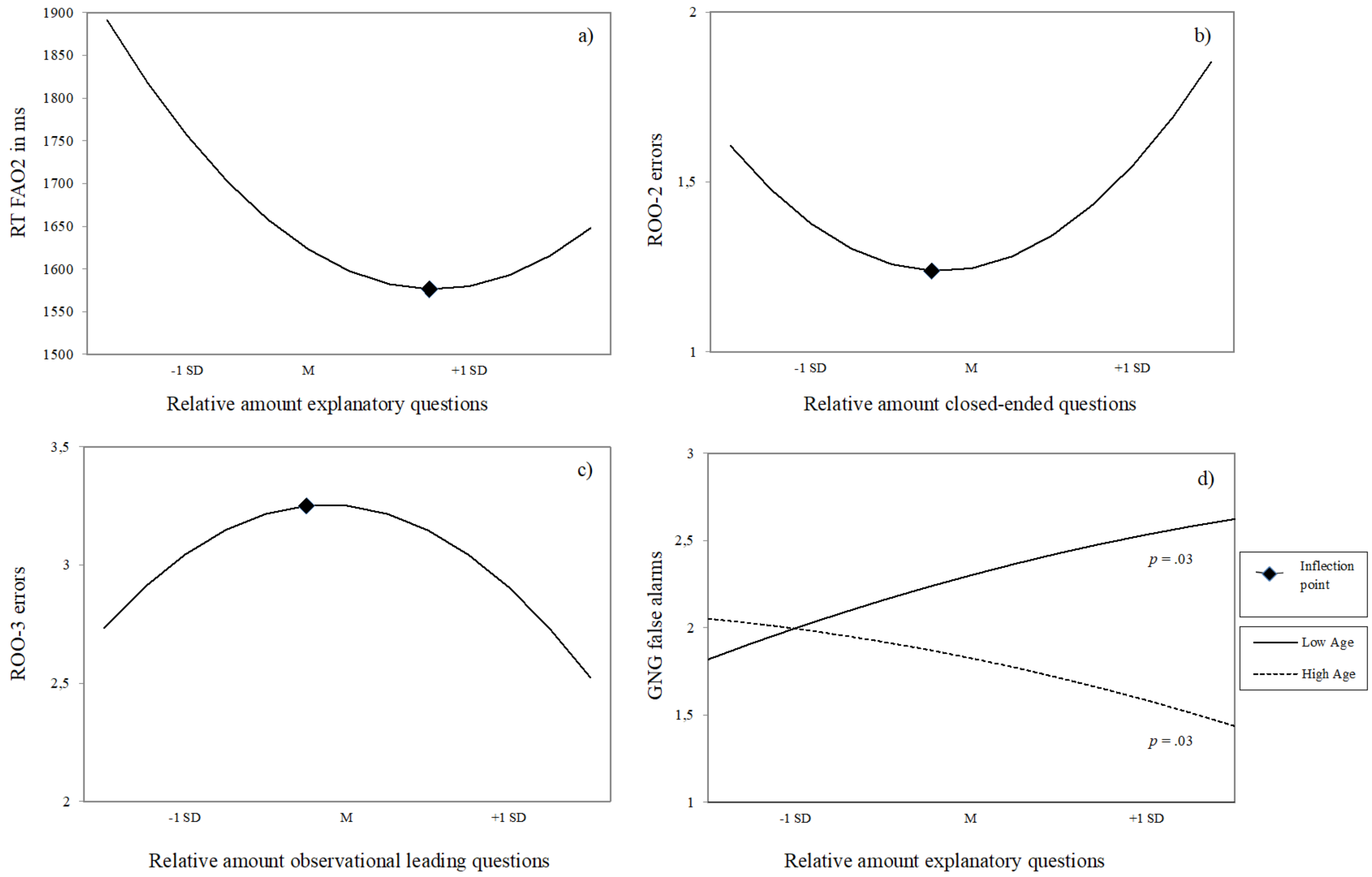

Figure 2. Convex relation between relative amount of explanatory questions and reaction time focused attention task (RT FAO2) (a). Convex relation between relative amount of closed-ended questions and number of errors inhibition task (ROO-2) (b). Concave relation between relative amount of observational leading questions and number of errors cognitive flexibility task (ROO-3) (c). Moderation effect of age on the relation between amount of explanatory questions and number of false alarms on an inhibition task (GNG) (d).

Discussion

The aim of the current study was to investigate whether aspects of parenting strategies, i.e. supportive presence, intrusiveness and aspects of verbal scaffolding, are also associated with child AC and EF skills in this older age group of 4- to 8-year-olds as they are in younger children, and to what extent these relations were similar within this age range. This study showed that aspects of AC and EF were related to these parenting strategies in this low risk group of typically developing children. AC components were significantly associated with intrusiveness and some aspects of verbal scaffolding. Regarding EF skills, especially inhibitory control showed robust associations with parental intrusiveness, supportive presence and aspects of verbal scaffolding. Working memory and cognitive flexibility were related to aspects of verbal scaffolding, but not to aspects of parental sensitivity. An interesting finding was the observation that several relations between parental strategies and AC or EF appeared to be moderated by age and that some relations were curvilinear.

Parenting strategies: relation with AC and EF

Parents who were more supportive, less intrusive, and who asked more open-ended questions had children with better inhibitory control. In addition, parents who asked relatively more open-ended than closed-ended questions had children with better inhibitory control, working memory skills and cognitive flexibility. This may suggest that parenting strategies can influence their children's EF skills also during early school years, in line with Sigel's model of psychological distancing (2002), and extending results from previous studies in younger age groups (e.g. Bernier et al., 2010; Conway & Stifter, 2012; Eisenberg et al., 2010; Hughes & Ensor, 2009; Kraybill & Bell, 2013; Matte-Gagné & Bernier, 2011; Neitzel & Stright, 2003; Sulik et al., 2015). Sigel's model entails that children learn self-regulation through interacting with parents who are sensitive and able to adequately scaffold experiences, building on earlier models emphasizing the importance of parent-child interaction in the development of self-regulation (e.g. Vygotsky, 1978; Kopp, 1982; Calkins, 1994). Nonetheless, the current study cannot give a definite answer on causality in this association. It may also mean that parents are, at least partially, adapting their behavior in accordance with their child's needs at that point in time. Certain parenting strategies could either be a cause or an effect of their child's self-regulation skills, or both; suggesting a reciprocal relation between parental strategies and children's functioning. For instance, Eisenberg and colleagues (2010) concluded that individual differences in self-regulatory skills predicted maternal scaffolding, suggesting that child skills may evoke specific parenting strategies. On the other hand, in a more recent study, Eisenberg and colleagues (2015) reported a bidirectional association between parental intrusiveness and child self-regulation, comparable to the reciprocal associations reported by Belsky, Fearon and Bell (2007) between parental sensitivity and child attentional control.

An interesting finding was that some associations between parenting strategies and child AC and EF were curvilinear. Children with better inhibitory control had parents who asked more than just a few, but not too many closed-ended or observational leading questions relative to other parents. Children with better AC had parents who asked relatively many explanatory questions, though not too many. On the other hand, children with better cognitive flexibility had parents who either asked a few or a lot of observational leading questions compared to other parents. These curvilinear associations may indicate that an adequate parenting strategy requires more than merely asking more questions and that asking questions in itself does not define adaptive parenting behavior. A recent study focusing on the association between child anxiety and parental intrusiveness also concluded that curvilinear effects may be the best fitting to depict parental influence on child development, as anxiety increased when mother's intrusiveness was on either end of the continuum (i.e. high or low) (Kiel, Premo, & Buss, 2016).

Our findings suggest that child self-regulation is likely to be influenced by parental strategies but a reversed relation is also possible, building on the idea of bidirectionality in parenting strategies and child functioning. Furthermore, more is not necessarily better, underscoring the importance of adaptive parenting strategies.

Age matters

Not all aspects of parenting and child self-regulation were associated across the entire age-range in this study. For instance, only younger children with parents who were less intrusive had better AC. At the same time supportive parenting was not at all related to AC in 4- to 8-year-olds. These findings are in line with the study of Mathis and Bierman (2015), who concluded that although parental intrusiveness was associated with low levels of child AC in 4- to 5-year-olds, no relation was found for parental support. As it was hypothesized that especially in older children parental intrusiveness would be negatively related to child AC, the absence of this association in our study was surprising (Cuevas et al., 2014). Though AC continues to develop during the primary school period, AC development is thought to have its peak during the preschool period (Garon et al., 2008). This might suggest that AC skills have mostly developed by the time children reach primary school age and parental influence on AC development may be limited afterwards, though our finding of an association between intrusiveness and AC in younger children suggests there may still be plasticity in AC development around age four to five.

Within our sample of 4- to 8-year-olds, we did not find age to act as a moderator in the relation between parental supportive presence or intrusiveness with EF development. Our findings supported the presence of a robust relation between supportive presence and intrusiveness with inhibitory control, but no association with working memory or cognitive flexibility was detected. The influence of parental support and intrusiveness on EF might only be detectable at an older age, as both working memory and cognitive flexibility show a longer developmental trajectory than inhibitory control (Best et al., 2009). This is in agreement with a recent study, showing parental sensitivity predicted inhibitory control but not working memory in four year-olds (Mileva-Seitz et al., 2015). It should be noted, however, that parental sensitivity may already be associated with neural development at an earlier age. Even though brain activity may change dramatically, this does not always lead to improved task performance (Johnstone et al., 2007) or these changes in neural activation may take time to result in improved behavioral performance (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). However, Bernier and colleagues (2010; 2012) have linked autonomy support (i.e. low intrusiveness) to an EF factor containing inhibitory control, working memory and cognitive flexibility, already in early childhood. These findings, however, may be mainly explained by the inclusion of inhibitory control in their EF factor. On the other hand, this study's observation that verbal scaffolding was already associated with the more demanding EF tasks assessing working memory and cognitive flexibility in 4- to 8-year-olds, might suggest that scaffolding challenges children's self-regulation skills more than aspects of parental sensitivity do. These tentative conclusions ask for longitudinal studies in large samples to disentangle the role of specific aspects of parenting in EF development.

Age also mattered in the relation between certain aspects of verbal scaffolding and AC and EF. Most interesting was the moderation effect of age on the association between explanatory questions and inhibitory control. Parents of older children with better inhibitory control asked relatively more explanatory questions, while this effect was reversed in younger children. An explanation of this interaction effect might be related to the difficulty level of the questions parents ask. According to Eshach and colleagues' (2014) taxonomy of question difficulty, this study's explanatory questions would be identified as high-order questions. Our finding may thus be due to the higher difficulty level of this question category in general. Perhaps asking explanatory questions is too demanding for younger children, while it is likely to be more adaptive for the older age group.

In sum, in the current study several associations between parental strategies and children's cognitive self-regulatory skills were found, suggesting that also young school-aged children could benefit from interacting with supportive, non-intrusive parents who ask challenging and relatively more open-ended questions. Several limitations of the current study need to be acknowledged. Parents may have acted differently than their usual self due to the somewhat artificial, though only slightly structured play setting during the joint-activity tasks. However, it should be noted that observing parent-child interaction under these relatively more natural conditions in the home is unlikely to distort the nature of interaction much (Gardner, 2000). Secondly, our coding system focused on parenting behaviors. Consequently, real-time bidirectional relations between parenting strategies and child behavior could not be investigated. Thirdly, children from only two Dutch schools in the same provincial region were included in this study, which limits the generalizability of our findings. Parents participating in this study were more likely to be highly educated (Central Bureau for Statistics [CBS], 2013) and the current sample may not accurately represent families from a lower educational background. Fourthly, relatively complex analyses were conducted using a modest sample size. However, cross-validation to avoid overfit models raised no major concerns and sample size was sufficient to detect at least moderate to even smaller effect sizes (Green, 1991). Finally, the current study assessed associations between parental strategies and child self-regulation cross-sectionally, and no inferences concerning developmental changes within children or causality can be made. This is particularly relevant for the age interaction effects described in this study, which may have been caused by differences between children instead of developmental differences within the same child, asking for studies examining these relations over time.

Strengths of this study include the assessment of AC and EF using well-validated age-appropriate neuropsychological tasks and the objective coding of observed parenting behaviors. This study points to possible opportunities to also teach parents of young school age children to be more supportive, less intrusive, and ask more open-ended and elaborative questions to help optimize their children's self-regulatory skills. Our findings suggest that age moderates the association between some aspects of parenting strategies and child self-regulation. Our results show that what may be an adequate parenting strategy for one child is not necessarily adequate for another child, whether the latter deviates in age, development or both. Diamond (2011) concluded that self-regulatory skills can be improved; our study suggests that parents may influence self-regulatory skills in their children by using adaptive parenting strategies and being able to flexibly change the way they interact with their child over time. Educating and training parents could benefit children's AC and EF development and the aspects of parental strategies investigated in the current study could be useful objectives. Research into the effectiveness of educating and training parents of low risk children about parental strategies that can stimulate their child's self-regulatory skills is needed to investigate whether changing parenting skills will result in better AC and EF skills in children.

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