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Curious minds: stimulating parent-child interaction to foster neurocognitive functioning in four- to eight-year-olds

Spruijt, A.M.

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Author: Spruijt, A.M.

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CHAPTER

4

Educating parents to improve
parent-child interactions: Fostering the
development of attentional control and
executive functioning

Based on Andrea M. Spruijt, Marielle C. Dekker, Tim B. Ziermans & Hanna Swaab

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ABSTRACT

Parent child interaction is essential in the development of attentional control (AC) and executive functioning (EF). Educating parents in AC and EF development may help them to respond more adaptively to their child's developmental needs. The aim of this study is to investigate whether parents can be educated to improve interactions with their child through a compact psycho-educational program that focuses on fostering the development of AC and EF. Parents and their children in a low-risk sample of four- to eight-year-olds were randomly assigned to either the educational program condition ($N = 34$) or the control condition ($N = 36$). Parental supportive presence and intrusiveness were observed during home visits and children's performance-based AC and EF were assessed before and after the four-session educational program. Parents in the educational program improved significantly in supportive presence ($\eta p^2 = .19$) and intrusiveness ($\eta p^2 = .09$) compared to controls. There was no short-term educational program mediation effect on child AC and EF through parental support and intrusiveness. This study showed, however, that only within the educational program condition, supportive presence and intrusiveness were significantly associated with AC and EF at post-test. Furthermore, parents who improved on support after the educational program had children who improved on AC and EF. Parental supportive presence and intrusiveness can be enhanced by using a compact educational program. Future studies should aim at examining variations in educational program responsiveness and assessing the associations between these parenting strategies and AC and EF over time.

Keywords: Parent educational program; Supportive presence; Intrusiveness; Attentional control; Executive functioning; School-aged children

The manner in which parents interact with their children influences their development and their school success (e.g. Englund, Luckner, Whaley, & Egeland, 2004; Trivette, Dunst, & Hamby, 2010). Parenting educational programs initially focused mainly on high-risk families, but more recently, programs also aim to optimize conditions for child development through the involvement of parents regardless of risk status (Ailincăi & Weil-Barais, 2013). The educational challenge of these kind of programs is to make parents aware of their own behavior and help them realize their influence on the behavior of their children. The aim of the current study is to investigate whether parents can be educated to improve the interactions with their child through a compact psycho-educational program that focuses on fostering the development of executive functions (EF) and attentional control (AC).

Fostering the development of EF and AC in young children has received increasing attention in recent years (Bierman & Torres, 2016). EF are adaptive neurocognitive processes fundamental to problem-solving that enable us to plan, guide and control goal-oriented behavior (Best, Miller, & Jones, 2009; Garon, Bryson, & Smith, 2008). There is general agreement that the three core EF components inhibition, working memory and cognitive flexibility are interrelated, but can be distinguished reliably (e.g. Miyake et al., 2000). These core EFs share a common underlying mechanism, often referred to as effortful attentional control. AC is intertwined with EF as an ongoing process essential for EF development (Garon et al., 2008). AC entails both the ability to actively focus on one thing without being distracted, known as focused attention, and the ability to maintain attention over prolonged periods of time, or sustained attention (Cohen, 2014). As both AC and EF have repeatedly been linked to the quality of development and the functioning in many important aspects of life, such as school performance, health, and job success (For a review, see Diamond, 2013), policy makers and practitioners recognize the relevance of preventive interventions targeting AC and EF development.

During the transition from dependence to greater autonomy, young children's AC and EF development is influenced by the relationship with their parents and the conditions in their caregiving environment (Bernier et al., 2012; Diamond, 2013; Fox & Calkins, 2003). Parent-child interaction is essential in the development of AC and EF, as adequate parenting provides support and external regulation in order for children to practice and internalize self-regulatory skills (Fox & Calkins, 2003; Giesbrecht, Muller, & Miller, 2010; Kopp, 1982; Sigel, 2002). As children grow up and increasingly seek out greater autonomy, many parent-child interactions can be marked as either supportive or controlling (Fox & Calkins, 2003). Supportive parenting requires parental understanding

of these changing developmental needs during the preschool years (Landry et al., 2008). However, achieving this understanding may be a difficult process for some parents. For instance, in one study only 25% of mothers from a low socio-economic background showed relatively stable high levels of sensitive responsiveness to their child's signals and another 25% even decreased dramatically between infancy and the preschool period (Landry, Smith, Swank, Assel, & Vellet, 2001).

Adequate parenting strategies, characterized by parents' ability to perceive and respond to their children's signals including attempts to support their child's need for independence, may foster the development of self-regulation. Indeed, parental support and intrusiveness have repeatedly been linked to the development of AC and EF in young children (e.g. Bernier, Carlson, & Whipple, 2010; Clark & Woodward, 2015; Cuevas et al., 2014; Fay-Stammbach, Hawes, & Meredith, 2014; Gaertner, Spinrad, & Eisenberg, 2008; Kraybill & Bell, 2013; Mathis & Bierman, 2015; Spruijt, Dekker, Ziermans, & Swaab, 2018; Sulik et al., 2015). Parental support refers to reassuring and supportive caregiving, while intrusiveness refers to lack of autonomy support or negative and controlling parenting (Dotterer, Iruka, & Pungello, 2012). While parent interventions aimed to improve school readiness (e.g. social cooperation, vocabulary) often include promoting supportive and non-intrusive parenting (For a review, see Welsh, Bierman, & Mathis, 2014), the effects of this type of intervention on child AC and EF development have not yet been examined.

Based on a growing body of neurodevelopmental research suggesting that self-regulation skills develop rapidly between ages four and eight (Best & Miller, 2010), a wide variety of preventive child interventions promoting AC and EF skills in young children has emerged over the last decade that show somewhat encouraging results. However, transfer to academic learning is often absent (e.g. Bergman Nutley et al., 2011; Dowsett & Livesey, 2000; Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009). Programs aimed at improving classroom quality and teacher-child relationships have shown more promising results, including positive effects on academic learning and AC and EF skills (e.g. Dias & Seabra, 2017; Raver et al., 2011). For instance, in a study by Raver and colleagues (2008), teachers in the intervention condition scored higher on sensitivity and showed higher levels of positive classroom climate than controls, suggesting that improving teacher-child interactions can promote self-regulation skills and academic performance in young children. These kinds of programs are often aimed at high-risk low-income samples, and therefore we do not yet know whether the effects are also generalizable to low-risk samples. Nonetheless, these findings are in line with the notion that high quality caregiving promotes the development of AC and EF skills in young

children (Bernier, Carlson, Deschenes, & Matte-Gagne, 2012). As such, it is surprising that hardly any parenting programs aimed at improving AC and EF development have been explored.

Whether and how much parents can facilitate the development of self-regulation in their children warrants further study (Bierman & Torres, 2016; Diamond, 2013). Regardless of the type of intervention, repetition appears to be essential for the best results (For a review, see Diamond, 2013). For instance, school curricula successful in promoting self-regulatory skills, involved repeated practice throughout the day and not just during one module (e.g. Diamond, Barnett, Thomas, & Munro, 2007; Raver et al., 2008; Riggs, Greenberg, Kusché, & Pentz, 2006). This suggests that educating parents to implement self-regulatory skills practice during daily routines outside the school setting, could be a valuable asset in promoting the development of AC and EF on a more regular basis. Interventions have shown the best results when self-regulatory skills were continually challenged with increasing demands, adaptive to the child's age and ability (e.g. Bergman Nutley et al., 2011; Holmes, Gathercole, & Dunning, 2009). Parents may become more involved in their children's learning when they are educated about how their child reasons and learns (Gleason & Schauble, 1999). In this sense, parents educated in AC and EF development may be better equipped to recognize their child's level of competence and facilitate AC and EF development by adaptively challenging their child's self-regulatory skills. With this increased parental understanding of their child's developmental needs, parents may thus be better able to perceive and supportively respond to their child's signals.

The Curious Minds parent educational program focuses on educating parents on how to support and scaffold the development of cognitive, social-emotional and self-regulatory skills necessary for adaptive behavior and learning while interacting with their child. The aim of the program is twofold: (1) to educate parents about their child's AC and EF developmental needs; and (2) to educate parents through home-assignments how they can stimulate AC and EF development as well as explorative behavior and reasoning abilities through interaction that is sensitive to their child's developmental needs. A major objective of this study is to examine whether the Curious Minds parent educational program is able to improve parental support and intrusiveness, which have been shown to have a positive impact on children's AC and EF. We hypothesized that parents in the educational program condition would show greater improvements in parental support and intrusiveness than controls. We expected associations between parenting strategies and child AC and EF to increase after the educational program,

as parents will have become more aware of their own behavior and have tuned their strategies to their child's needs. Additionally, we investigated whether parental support and intrusiveness would mediate the association between the educational program condition and the children's AC and EF performance after finishing the program, and hypothesized a significant mediation effect. Furthermore, we hypothesized that parents within the educational program condition whose interaction with their child improved most, had children who also improved most on AC and EF.

METHOD

Participants

The current study is embedded within the Curious Minds program: a longitudinal program investigating the development of executive and social functioning in primary school-aged children in the Netherlands and evaluating the effects of a parent and a teacher educational program (approved by the Ethical Board of the department of Education and Child Studies at Leiden University (ECPW-2010016)).

Parents of 138 4- to 8-year-old children ($M = 6.26$ years, $SD = 1.19$, 55.1% male) 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 Rotterdam-The Hague Metropolitan Area were eligible for this particular study and signed an informed consent letter. The current study uses observational data of parents' interactive behavior with their child collected during a home visit and child, computer-based neurocognitive measures of AC and EF. Children were randomly assigned to either the parent educational program condition (EPC) or the control condition (CC). Participants were included in analyses when their parents had agreed to home visits, when parents attended at least two group sessions (EPC only), and when complete pre- and post-test data were available.

Parents of 99 out of the 138 eligible children agreed to both home visits (response = 71.7%). Participants whose parents agreed to home visits did not significantly differ from those who did not agree to home visits on the background variables: age, gender, school, grade, or prevalence of referral to mental health care in the past year; nor did their parents significantly differ on single parenthood status or parental education (all $p > .05$). Participants in the EPC who missed all ($N = 18$) or three out of four ($N = 5$) sessions were excluded from analyses and also did not significantly differ from those who remained in the EPC on any of the background variables (all $p > .05$). The final sample size

for analysis ($N = 70$) consisted of 34 children in the EPC and 36 in the CC. For detailed sample characteristics, see Table 1.

Table 1. Participant characteristics and descriptive statistics variables of interest.

Educational program analysis	Total ($n=70$)	EPC ($n=34$)	CC ($n=36$)	p
Age in months at T1 (M (SD))	76.25 (14.49)	76.56 (14.89)	75.97 (14.32)	.87
Sex (%male)	55.71	47.06	63.88	.16
Parental education^b				.91
High (%)	44.77	43.75	45.71	
Medium (%)	47.76	50.00	45.71	
Low (%)	7.46	6.25	8.57	
Single parenthood (%)	4.48	6.25	2.86	.60
Referral to mental health care past year (%)	7.46	6.25	8.57	.72
Parental sensitivity T1^c				
Supportive presence (M (SD))	3.94 (1.52)	3.88 (1.61)	4.00 (1.44)	.61
Intrusiveness (M (SD))	3.73 (1.44)	3.62 (1.41)	3.83 (1.47)	.73
Child factors T1				
Attentional control (M (SD))	.28 (2.22)	.37 (2.47)	.20 (1.98)	.76
Executive functioning (M (SD))	.31 (1.91)	.38 (1.80)	.25 (2.04)	.78
Principal component analysis^d	Total			
	($n=225$)			
Age in months at T1 (M (SD))	73.53 (14.65)			
Sex (% male)	54.22			
Parental education^a				
High (%)	49.04			
Medium (%)	46.15			
Low (%)	4.81			
Single parenthood (%)	5.30			
Referral to mental health care past year (%)	7.96			

^aBackground information was missing for $N=17$ children due to non-response on parent questionnaires. ^bBackground information was missing for $N=3$ children due to non-response on parent questionnaires. ^cOriginal values before standardization. ^dSee Appendix. EPC=Educational program condition; CC=Control condition.

Procedure

Pre-test baseline data were collected in the period between November 2013 and February 2014 (school 1) and between May and June 2014 (school 2). Post-test data were collected in the period between June and July 2014 (school 1) and between January and February 2015 (school 2). Computer-based performance tasks were administered during an individual test session of approximately 60 minutes in a separate quiet room at the child's school. Tests were administered by two trained junior investigators or by one of the senior investigators. Children were rewarded for participation with a small token of appreciation after the test session.

Curious Minds educational program

The content of the educational program was inspired by the Vygotskian principles of the Tools of the Mind curriculum for pre-school children (Bodrova & Leong, 2007; Diamond et al., 2007), which focuses on supporting and scaffolding the development of cognitive, social-emotional and self-regulatory skills necessary for adaptive behavior and learning using a familiar adult in a real-life setting as a change agent. The program was provided by a skilled clinical neuropsychologist specialized in child and adolescent neurodevelopment after all baseline assessments were completed, and consisted of four, monthly group sessions of approximately two hours each at the child's school. The caregiver of each child who also participated in the home visits was asked to attend the group sessions.

During each session, the focus was on a specific (neuro)cognitive mechanism, for which parents received basic information about the brain-behaviour developmental course at specific ages, using everyday examples of parent-child interaction. Parents also received a workbook summarizing information about development, as well as matching home assignments following each session to enhance the learning experience of parents. These home assignments were discussed during the following session, allowing parents to learn from the educator's feedback and each other's day-to-day experiences. For a more detailed description per session, see Table 2.

Measures

Demographic characteristics

Parents filled out a complementary background information questionnaire, using the online survey software Qualtrics (<http://www.qualtrics.com/>). The highest completed level of education was used as an indicator of educational attainment according to the Dutch Standard Classification of Education (SOI) which is based on UNESCO's International

Table 2. Description of the discussed topics and home assignments per session of the Curious Minds educational program.

Session	Main theme	Home assignments
Session 1	How children learn and process new information, how this is regulated through AC and EF and how parents can help their child explore new topics in more depth by being more supportive, less intrusive and by asking questions.	e.g.: - Do science experiments with soap bubbles - Think outside the box by imagining as many different uses for a paperclip as possible. - Play sensory games, such as touching and tasting different types of food while blindfolded.
Session 2	Teaching parents how to stimulate specific aspects of AC and EF while interacting with their child. Discussion of home assignments session 1.	e.g.: - Tell two different stories to your child simultaneously, while your child focuses on one of the stories, and ask questions afterwards about its content (targeting <i>attention</i>). - Play the game <i>Yes and no are forbidden</i> : trick your child into answering questions with 'yes' or 'no' (targeting <i>inhibition</i>). - Play the <i>Going on a trip</i> game: alternately add an item to the sentence 'I am going on a trip and I am going to pack...', after recalling all items that have been mentioned (targeting <i>working memory</i>). - Let your child come up with alternative plans when a playdate is suddenly cancelled, and observe whether your child is able to flexibly change plans (targeting <i>cognitive flexibility</i>).
Session 3	Teaching parents how to stimulate emotion regulation and social cognition while interacting with their child. Discussion of home assignments session 2.	e.g.: - Practice and discuss a range of facial emotion expressions in front of the mirror. - Observe and address your child's emotional reactions during daily interaction and describe the reactions. - Discuss several short, illustrated stories (e.g. <i>How does Billy feel when he's not allowed to play with the other kids? How do you know?</i>) - In a naturally occurring situation, explain why it is important to place yourself in someone else's shoes (i.e. perspective taking), using questions.
Session 4	Recap of sessions 1 through 3; parents were free to discuss what they had learned and ask additional questions. Discussion of home assignments session 3.	There were no home assignments following session 4.

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 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.

Parental support and intrusiveness

The parent's interactive behavior with the child was videotaped at pre- and post-test home visits during two joint activity tasks. These tasks consisted of a combining task and a sorting task of approximately five to ten minutes each, both based on tasks designed by Utrecht University (Corvers, Feijs, Munk, & Uittenbogaard, 2012). The videotapes were coded afterwards for level of parental supportive presence and intrusiveness using the revised Erickson 7-point scale for Supportive Presence and Intrusiveness (Egeland, Erickson, Clemenhausen-Moon, Hiester, & Korfmacher, 1990). A parent scoring high on Supportive Presence is reassuring when the child is experiencing difficulty with the task and gives emotional support to the child. A parent scoring high on Intrusiveness lacks respect for the child's autonomy and does not acknowledge the child's intentions or desires (For detailed task and coding descriptions, see Spruijt et al., 2018)).

Attentional control and Executive Functioning

AC and EF were measured with several neuropsychological tasks from the Amsterdam Neuropsychological Tasks (ANT, version 2.0), assessing focused and sustained attention, inhibition, working memory and cognitive flexibility. The ANT is 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, that has shown good test and test-rest reliability ($r = 0.84$) in adults (Wostmann et al., 2013) and comparable paradigms have also shown adequate test-retest stability in children (Kindlon, Mezzacappa, & Earls, 1995), as well as the Hearts and Flowers paradigm which has been validated for children as young as four years old (Davidson, Amso, Anderson, & Diamond, 2006; Diamond et al., 2007). All computer tasks were preceded by instructions and practice trials (For detailed task descriptions, see Appendix, Table 1 and Spruijt et al., 2018)).

Data analyses

Data were analyzed using IBM SPSS version 23. Demographic characteristics for both schools and conditions were compared with chi-square tests, independent t-tests and Fisher exact tests. Principal component analysis was conducted on the pre-test ANT data of the larger Curious Minds sample ($N = 225$) to form coherent and relatively independent subsets of variables to reduce the number of observed ANT variables to a smaller number of components (see Appendix).

The educational program effect on post-test parental support and intrusiveness was assessed using ANCOVA controlling for their corresponding pre-test values. Partial correlations were calculated to explore whether the associations between parenting strategies and AC and EF components differed for the EPC and CC and whether these associations changed after the educational program. The educational program effect on AC and EF components through mediation by supportive presence and intrusiveness was assessed using bootstrapping, a nonparametric resampling procedure (Hayes, 2009). Bootstrapping with 5000 resamples was done to test for significant indirect effects using the SPSS macro developed by Preacher and Hayes (2009). Pre-test values and age were controlled for in all analyses. Post hoc regression analyses with sensitivity change scores within the EPC were conducted to assess whether especially those parents who improved after the program on supportive presence and intrusiveness had children who improved on AC and EF. Change scores were calculated by subtracting pre-test from post-test scores and reversing the intrusiveness change score. For all significant effects, partial η^2 addressed effect size (0.04 = small effect; 0.25 = moderate effect; 0.64 = strong effect (Ferguson, 2009). Alpha for significant effects was set at $p \leq .05$.

RESULTS

Sample characteristics and descriptive statistics for the variables of interest are displayed in Table 1. Participants in the EPC did not significantly differ in age, gender, school, grade, single parenthood status, parental education or prevalence of referral to mental health care in the past year from those in the CC. Neither did they differ on level of AC or EF at pre-test (all $p > .05$).

Curious Minds educational program effects

Parent-child interaction

At post-test, parents in the EPC scored significantly higher on support ($\eta_p^2 = .19$), showing a small to moderate effect size, and lower on intrusiveness ($\eta_p^2 = .09$), a small effect, than parents in the CC, while controlling for pre-test parenting scores (see Table 3 and Figure 1).

Table 3. Analysis of covariance (ANCOVA) results comparing educational program and control condition on parenting strategies at posttest, controlling for corresponding pre-test score.

	EPC M (SD)	CC M (SD)	F (df)	η_p^2	p
Parenting strategies					
Supportive presence	.26 (.94)	-.32 (.92)	15.87 (67)	.19	<.001
Intrusiveness	-.24 (.87)	.28 (.96)	6.42 (67)	.09	.01

Note. M: Mean. SD: Standard deviation. η_p^2 : Partial eta squared. EPC=Educational program condition; CC=Control condition.

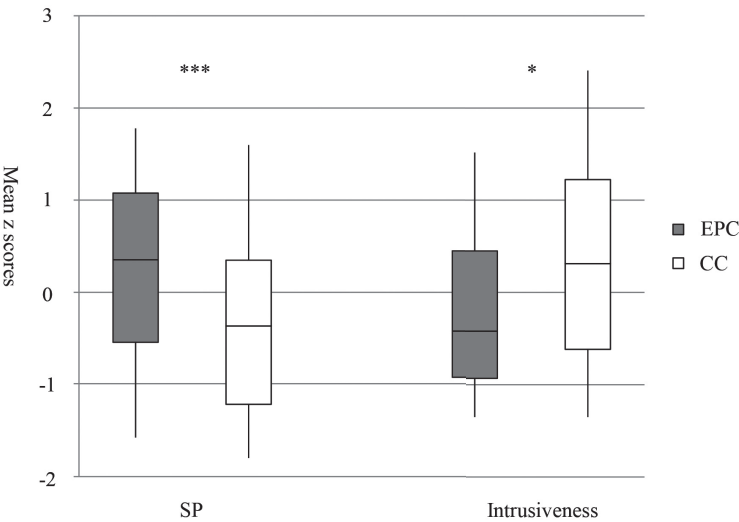


Figure 1. Educational program effect at post-test on parental supportive presence and intrusiveness for the Educational program condition (EPC) and Control condition (CC), controlled for pre-test values.

Parent-child interaction with AC and EF: differential associations between conditions

We explored whether the associations between parenting strategies and AC and EF components differed for the EPC and CC and whether these associations changed after the educational program. At pre-test, parental support and intrusiveness were not associated with child AC and EF components (see Table 4). At post-test however, support and intrusiveness of parents in the EPC were significantly associated with child AC and EF components. No such associations were found in the CC.

Mediating effect of parent-child interaction on AC and EF

Next, we investigated whether the educational program produced a short term effect on child AC and EF, mediated by support and intrusiveness. Even though regression coefficients between EPC and both parental support and intrusiveness were significant, standardized indirect effects for AC and EF were non-significant (see Table 5). This indicates that support and intrusiveness did not act as a significant mediator between EPC and AC and EF.

Differential effects within the educational program

Within the EPC, regression analyses showed that a higher change score for supportive presence at post-test was significantly associated with better AC ($\beta = .21, p = .03$) and better EF ($\beta = .30, p = .05$) at post-test, controlled for pretest values of AC and EF and age. A higher change score for intrusiveness was marginally associated with better AC ($\beta = .20, p = .06$), but not EF ($\beta = .05, p = .74$) at post-test. No such associations were found in the CC.

Table 4. Partial correlations for the educational and control condition among observed parenting behaviors and child AC and EF, controlled for age.

Child components	Educational condition (N=34)				Control condition (N=36)			
	SP T1	I T1	SP T2	I T2	SP T1	I T1	SP T2	I T2
1. AC T1	.29	-.18			-.06	-.09		
2. EF T1	.11	-.05			.23	-.27		
2. AC T2			.49**	-.53**			.19	-.13
4. EF T2			.34†	-.38*			-.11	.01

† $p < .10$; ** $p < .05$; *** $p < .01$. SP=Supportive Presence; I=Intrusiveness.

Table 5. Bootstrapping analyses results with parenting as a mediator in the relation between educational program condition and AC and EF.

Mediator	Direct effect program - parenting	AC			EF		
		95% CI		b (SE)	95% CI		Up
		Low	Up		Low	Up	
Total effect program				.34 (.32)	-.31	1.00	.95
Covariate age				.09 (.01)***	.06	.12	.03
Covariate T1 AC/EF				.19 (.10)†	-.01	.40	.75
Supportive presence	.65 (.16)***	.31	.98				
Direct effect program – AC/EF				.10 (.35)	-.62	.81	.91
Indirect effect (mediation)				.25 (.17)	<-.01	.68	.46
Intrusiveness	-.46 (.19)*	-.84	-.07				
Direct effect program – AC/EF				.22 (.33)	-.45	.90	.92
Indirect effect (mediation)				.13 (.13)	-.04	.51	.31

Note. Results based on 5000 bootstrapped samples. 95% CI = bias-corrected and accelerated confidence intervals, with $p < .05$ when range lower-upper CI does not include zero. Covariate T1 AC/EF refers to corresponding pretest component.

DISCUSSION

The aim of the current study was to investigate whether parents can be educated to improve interactions with their child through a compact psycho-educational program with home-assignments. Focusing on parenting strategies that have been shown to have positive impact on children's attentional control (AC) and executive functioning (EF), this study showed in a low-risk sample of four- to eight-year-olds that parents in the educational program condition scored significantly higher on supportive presence and lower on intrusiveness than controls. Though parenting strategies did not act as a mediator between educational condition and child AC and EF, children of those parents who improved after the educational program showed enhanced AC and EF performance.

At post-test, parents in the Curious Minds educational condition were more supportive and less intrusive towards their child during joint activity problem-solving tasks than controls were. This is in line with the positive results regarding programs aimed at improving teacher-child relationships in order to promote self-regulatory skills (e.g. Raver et al., 2008). Our study results suggest that certain aspects of parental sensitivity can indeed be improved using a compact educational program teaching parents about how their child reasons and learns, and how to implement self-regulatory skills practices during daily routines. Potential benefits of this educational group program in comparison to for instance home visiting programs targeting school readiness (For a review, see Welsh et al., 2014), include its high cost-effectiveness and wide employability.

Adequate parenting strategies, characterized by attempts to support the child's need for independence, have already repeatedly been linked to child AC and EF (e.g. Bernier et al., 2010; Clark & Woodward, 2015; Cuevas et al., 2014; Fay-Stammbach et al., 2014; Gaertner et al., 2008; Kraybill & Bell, 2013; Mathis & Bierman, 2015; Spruijt et al., 2018; Sulik et al., 2015). This suggests that educating parents may be a valuable asset in promoting the development of AC and EF, as they can implement self-regulatory skills practice during natural daily routines at home (Bierman & Torres, 2016). However, in the current study it was found that the Curious Minds educational condition did not lead to an overall improved AC and EF at post-test through changes in parental support and intrusiveness.

Several aspects that may explain this lack of effect on child outcomes have to be considered. First of all, previous studies have shown that greater benefits in AC and EF skills can be achieved in children who have larger initial deficits (Diamond & Lee, 2011; Diamond & Ling, 2016; Flook et al., 2010; Karbach & Kray, 2009; Tominey & McClelland,

2011). Self-regulatory skills are often delayed in children growing up in a low-income household with parents with low educational backgrounds (Noble, McCandliss, & Farah, 2007). As the current sample consists of low-risk children with parents who were less likely to have low levels of education (Central Bureau for Statistics [CBS], 2013), this may help explain why no detectable effect on child AC and EF was yet discernable after about a half year.

Second, due to restrictions related to school logistics, post-test data had to be assembled directly after completion of the educational program. Perhaps parents need more time implementing what they have learned before measurable improvements in AC and EF development can be observed. Programs that have improved teacher-child relationships (e.g. Raver et al., 2008), and which have shown to positively impact child self-regulatory skills (e.g. Raver et al., 2011) included at least two months of implementation time after the final session before posttest data were collected. Therefore, effects on child AC and EF may become apparent with time. This is in line with the findings of Dias and Seabra (2017), who have shown that EF gains after a teacher program were amplified at a one-year follow-up compared to direct posttest measurements, suggesting that some effects may indeed be larger later than directly after completing the program (Diamond & Ling, 2016). These conclusions imply a need for longitudinal studies with multiple post-test measurements to disentangle whether an educational program can achieve generalized and sustained effects on AC and EF development.

Third, the educational program consisted of four sessions, which may have been too few to result in discernable improvements in AC and EF development. Interestingly however, post hoc analyses showed that especially those parents who participated in the program and who showed increased supportive presence at post-test, had children who also showed improved AC and EF skills at post-test. As this association was not found in the control condition, this may indicate that parents who benefitted from the program did not only improve in supportive presence and intrusiveness but also altered their scaffolding in interaction with their children to be more beneficial to their child's AC and EF development. Future research needs to focus on this and other aspects of parent-child interaction that might enhance AC and EF development, and needs to find factors that will help explain why some parents benefit from an educational program, while others do not. Little is known about variations in educational program responsiveness and possible moderators affecting program success on stimulating child development. Future studies might include moderating variables that are, for instance, found in meta-analytical studies focusing on child externalizing behavioral problems. These studies showed that

program success was moderated by economic disadvantage, severity of initial problem behavior, parental educational level and parental psychopathology (Lundahl, Risser, & Lovejoy, 2006; Reyno & McGrath, 2006). Nonetheless, even small improvements in self-regulatory skills may result in large benefits regarding outcomes in later life (Moffitt et al., 2011), suggesting even small effects may become more and more prominent with time.

Fourth, as the opportunity to practice self-regulatory skills in a natural setting with a familiar adult may be the most promising approach to achieve generalized gains (Bierman & Torres, 2016) and repetition of self-regulatory skills practice throughout the day is essential for success (Diamond, 2013), educational program effects on child outcomes may become more feasible when the school environment is also targeted. As such, greater benefits in child AC and EF may be observed when using a more integral approach, targeting both the school and the home environment. Future studies should aim to disentangle the effects of approaches aimed at parents as the sole recipient and more integral approaches, targeting the home and school environment both separately and complementarily.

Several limitations need to be acknowledged. Parents may have acted differently during home visits than usual due to the somewhat contrived joint-activity tasks. However, it should be noted that observing parent-child interaction under these relatively more natural conditions in the home environment is not expected 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 were not 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. Fourth, not all parents who were assigned to the educational condition participated or completed all sessions, which may have biased our results due to selective drop-out. However, parents who were excluded from analyses did not significantly differ from those who remained in the educational condition, suggesting no attrition bias. Fifth, during the Curious Minds educational program, the home assignments were not checked or monitored. Unfortunately, we do not have detailed information on the amount and quality of practice for each parent. Nonetheless, home assignments were discussed freely every following session, possibly generating cohesiveness and social pressure to complete the assignments.

This study is among the first few to examine manners in which parents can be educated to facilitate the development of self-regulation in their children by using a compact educational program. Strengths of this study include randomizing to condition

within each school rather than assigning schools to different conditions, limiting classroom effects. Furthermore, observed parenting behaviors were coded objectively with high interrater reliability and well-validated age-appropriate neuropsychological tasks were used to assess child AC and EF. In sum, the current study showed that the Curious Minds educational program had the expected impact on the quality of parent-child interactions by improving parental support and intrusiveness compared to controls. Though no short-term mediation effects were found on child AC and EF through parental support and intrusiveness, we are reluctant to draw firm conclusions on these results alone, and tentative results suggested that especially parents in the educational condition who improved on parental support had children with better AC and EF skills. Future studies should aim at examining variations in educational program responsiveness and assessing these relations over time. In addition, combining parent- and teacher programs may have the greatest potential for enhancing development.

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APPENDIX

Principal Component Analysis

Preliminary tests indicated that the data were suitable for principal component analysis, with Kaiser Meyer Olkin measure = .81 and Bartlett's test of Sphericity = 573.53, $p < .001$. Results of the Scree-Test showed that a two-component solution fit the data best. Results of the Oblimin rotation showed substantive loadings (i.e. $> .30$) on Component 1 (eigenvalue = 3.45) and Component 2 (eigenvalue = 1.07; see Table 1). We labeled the extracted components *Attentional control (AC)* and *Executive functioning (EF)*. AC and EF pre- and post-test component scores were computed using the component loadings, including lower ($< .30$) loadings. Composite scores were reversed, with higher scores indicating better performance on AC and EF. The Pearson r correlation coefficient between the AC and EF component was .43. With a mean time of 6.23 months ($SD = 1.00$) in between measurements, stability between pre-test and post-test in the control group ($N = 57$) for the AC component ($r = .70$) and the EF component ($r = .69$) was high.

Table 1. Principal component analysis results^a for attentional control and executive functioning variables of the Amsterdam Neuropsychological Tasks (ANT; $N=225$).

<i>Measures</i>	<i>Component loading</i>	
	<i>C₁</i>	<i>C₂</i>
%variance explained	49.24	15.28
Focused attention (FAO2)	.97	-.17
Sustained attention (SAO2)	.89	.01
Interference control (GNG misses)	.60	.31
Working memory (STS)	-.53	-.42
Inhibitory control – no response (GNG false alarms)	-.05	.65
Inhibitory control – different response (ROO 2)	.02	.82
Cognitive flexibility (ROO 3)	-.03	.71

Note: ^aTwo component solution (Pattern matrix), Oblimin rotation. Component loadings $\geq .30$ are displayed in bold. FAO2=Focused Attention Objects – 2 keys; SAO2=Sustained Attention Objects -2 keys; GNG=Go-NoGo; STS=Spatial Temporal Span; ROO=Response Organization Objects.

