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Attentional Shifting Mediates the Relationship between **Parenting and Working Memory**

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ABSTRACT

A growing body of research has found a relationship between parenting and the development of executive function in young children; however, fewer studies have examined how parenting is related specifically to the development of working memory. Using data from the Family Life Project, this study examined whether attention was a pathway through which parenting predicted working memory. A total of 1,292 children were followed from birth to 36 months. Parenting was measured at 6, 15, 24 and 36 months. Children's attentional focusing and attentional shifting were measured at 24 months, and verbal working memory at 36 months. Sensitive, autonomy supportive and cognitive stimulating parenting at 6 months predicted better attentional shifting at 24 months, which, in turn, predicted greater working memory at 36 months. Sensitive, autonomy supportive and cognitive stimulating parenting at 15 months predicted greater working memory at 36 months. This study provided evidence that attentional shifting is a link for the association between parenting and working memory.

Introduction

Working memory involves the updating, maintenance and manipulation of information in the mind (Miyake & Shah, 1999), and is one of the components of executive function (EF). Working memory develops rapidly in early childhood (Garon, Bryson, & Smith, 2008), and is predictive of many domains of cognition, including school readiness and development of psychopathology (Alloway & Alloway, 2010; Pennington & Ozonoff, 1996). A growing body of literature has found that parenting is related to the development of EF (e.g., Bernier, Carlson, & Whipple, 2010; Fay-Stammbach, Hawes, & Meredith, 2014), but many, although not all (e.g., Mileva-Seitz et al., 2015), of these studies use a composite score of EF (e.g., Daneri et al., 2019), which, while useful, does not allow for the relationship between parenting and different components of EF to be distinct. The research that has been done finds that sensitive and autonomy supportive parenting is related to better working memory (e.g., Bernier et al., 2010); and harsh and insensitive parenting is associated with working memory problems in young children (e.g., Lucassen et al., 2015). However, our knowledge of the mechanisms that underlie the relationship between parenting and working memory is limited (Fay-Stammbach et al., 2014). The



current study adds to our understanding of the development of working memory by investigating the relationship between parenting, attentional control, and working memory in a longitudinal sample.

Parenting and attentional control

Parenting behaviors are often classified on dimensions of sensitivity, supporting autonomy, behavioral control/discipline, and cognitive stimulation (Bernier et al., 2010; Matte-Gagné & Bernier, 2011). Sensitive parenting is parenting that is warm and responsive to children's desires and needs (Bernier et al., 2012). Autonomy supportive parenting includes behaviors that support children's goals and desires, take children's perspectives, and respect their learning pace (Matte-Gagné & Bernier, 2011). Harsh discipline and intrusive parenting is strict and high-demanding and, thus, can undermine children's self-regulation (Lucassen et al., 2015). Cognitive stimulation includes providing an enriched environment for children to learn and practice new knowledge and skills (Bradley, McKelvey, & Whiteside-Mansell, 2011). These parenting behaviors are believed to influence children's attentional control, which includes attentional focusing, the ability to maintain focus on tasks, and attentional shifting, the ability to switch focus from one activity/task to another (Putnam, Gartstein, & Rothbart, 2006).

Early in life, warm and responsive parents are more attuned to their children's cues during parent-child interactions, which set the foundation for joint attention, and parents train and regulate children's attentional control through joint attention (Brandes-Aitken et al., 2020). Warm, autonomy supportive, and cognitively stimulating parenting also facilitates children's engagement with the surroundings and, therefore, promotes their interests in activities and provides external regulation of their attention, which can help them develop internal regulation of their attention (Bernier et al., 2010; Gaertner, Spinrad, & Eisenberg, 2008). Additionally, children whose parents are warm and sensitive are more likely to internalize parents' requests for desirable behaviors, including those that require children to engage in a task (Kochanska & Aksan, 1995), and, as a result, children are better at focusing/shifting attention to self-regulate, e.g., shifting attention away from an unpleasant event.

Children whose parents are intrusive, harsh and punitive, however, are more likely to have affective over-arousal and have difficulty allocating attention to developing skills, which compromises their learning and their behavioral and emotional regulation (Hoffman, 2001). Relatedly, parental intrusiveness and control at 18 months have been linked with lower focused attention in young children one year later (Gaertner et al., 2008).

Research suggests that parenting contributes to individual differences in attentional focusing and attentional shifting in young children, yet only a few studies (e.g., Mileva-Seitz et al., 2015) have investigated whether parenting in the first couple of years, e.g., as early as 6 months, plays a role in the development of attention. In addition, little work has addressed how parenting behavior is linked to different aspects of attention. This study, in part, examined whether parenting, measured at multiple time points in infancy and toddlerhood is related to the development of attentional focusing and attentional shifting, measured by parent report, in young children.



Attentional control and working memory

The development of attention provides the basis for learning and cognitive development (Gaertner et al., 2008), including the development of working memory (Rueda, Posner, & Rothbart, 2005), and a period of rapid growth in attention during early childhood overlaps with a developmental spurt in working memory (Rueda et al., 2004). Working memory in adults is highly associated with attentional control (Engle, 2002), suggesting that attentional control is involved in working memory. Espy and Bull (2005) examined the relationship between attention and working memory in 3- to 6-year-olds and found that those who had a higher working memory capacity were more proficient at disengaging and controlling attention. In 4- to 8-year-olds better sustained attention was related to more developmentally advanced spatial working memory (Beattie, Schutte, & Cortesa, 2018).

Although research findings support a link between attentional control and working memory in young children, there is little research examining the relationship between different aspects of attention and working memory in young children. Moreover, most research has examined the relationship between attention and working memory concurrently. Less is known about how different attentional mechanisms are related to working memory over time. Given the relationships between parenting and attention and between attention and working memory, the goal of the current study was to examine whether attentional focusing and attentional shifting were pathways through which parenting predicted working memory in young children. Using data from the Family Life Project, this study tested the following research hypothesis: Parenting that is higher in sensitivity, warmth, cognitive stimulation and autonomy support, and lower in intrusiveness and detachment, would predict better working memory through children's attentional focusing and attentional shifting (Figure 1).

Attention was measured using the Early Childhood Behavior Questionnaire (ECBQ). Although parental report is not an ideal measure of attention, parent report has been found to be related to other measures of attention. For instance, parent report of duration of orienting in 13.5-month-olds' was associated with the length of sustained play observed in the lab (Rothbart,, et al., 2000); and parent report of attentional focusing at 18 months

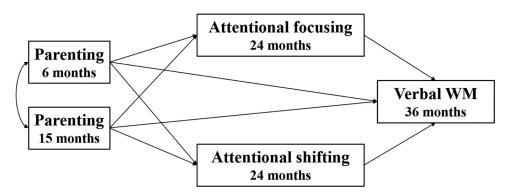


Figure 1. Conceptual model: the predicted relationship between parenting, attention and verbal working memory.

predicted toddlers' focused attention during play one year later (Gaertner et al., 2008). Family income impacts both parenting and children's cognition (e.g., Evans & Schamberg, 2009), so family income was included as a control variable.

Method

Participants

We used data from the Family Life Project, Phase I. Phase I followed 1,292 children from rural areas of Eastern North Carolina and Central Pennsylvania from birth to 3 years of age. Among them, 58.4% reported being European American, 41.2% African American, and 0.3% other race/ethnicity. About 18.1% reported less than high school, 32.5% high school, 34.7% less than college and 14.7% college degree and above. Low-income families were oversampled. See Vernon-Feagans et al. (2013) for detailed information. See Table 1 for number of participants included in each variable.

Measures

Working memory

Verbal working memory was measured at 36 months with the Backward Word Span Task. In this task, a child repeated the words an experimenter said in reverse order. The first trial included two words. If a child correctly repeated the words, one more word was added at the next level, up to a maximum of five. A child could complete up to three practice trials. Children who did not complete at least one practice trial correctly were not included in testing (28, 2.5% of children). A child's longest word span was analyzed.

Attention

Attention was measured by the Early Childhood Behavior Questionnaire at 24 months (Putnam et al., 2006). A parent rated their child's behaviors on a 7-point Likert scale from 1 (Never) to 7 (Always). The questionnaire consists of 34 items and six subscales. Only the attentional focusing and attentional shifting subscales were analyzed. See Putnam et al. (2006) for more information about the Early Childhood Behavior Questionnaire. Internal reliability of the attentional focusing and attentional shifting subscales was 0.55 and 0.60, respectively.

Table 1. Descriptive statistics.

Variables	N	Mean	SD
Parenting at 6 months	1141	2.67	0.64
Parenting at 15 months	1036	2.63	0.66
Parenting at 24 months	987	2.67	0.74
Parenting at 36 months	987	2.70	0.66
Attentional focusing at 24 months	1009	4.13	0.66
Attentional shifting at 24 months	1038	4.45	0.89
Verbal WM at 36 months	1014	3.30	0.92
Income at 24 months	996	1.87	1.63
Income at 36 months	981	1.95	1.57



Parenting

Parenting was measured during a 10-min parent-child interaction at 6, 15, 24 and 36 months. Parent-child dyads played as they normally would during a free play session (at 6 and 15 months) or completed a puzzle task (at 24 and 36 months). Parenting behaviors were rated by the experimenters on a 1-5 scale, with 1 being not at all characteristic and 5 being highly characteristic (NICHD Early Childcare Network, 1997). Coders rated (a) parental sensitivity, i.e., how the parent observed and responded to the child's needs, desires, fears and frustrations; (b) intrusiveness, i.e., how much of the interaction was parent-centered with the parent imposing their agenda; (c) detachment, i.e., parent was emotionally uninvolved and unaware of the child's need for appropriate interaction; (d) positive and negative regard, i.e., positive and negative feelings expressed toward the child; (e) animation of the parent; and (f) stimulation of development, i.e., parent provided appropriate levels of stimulation (Wu & Feng, 2020).

The inter-rater correlations for the different parenting dimensions at 6 months ranged from .69 to 0.79, from 0.75 to 0.80 at 15 months, from 0.77 to 0.86 at 24 months, and from 0.76 to 0.86 at 36 months. Factor analyses conducted for parenting behaviors at each age indicated one parenting component; thus, we created a composite score for each time point by averaging ratings from each parenting dimension.

Family income-to-needs ratio

The family income-to-needs ratio was collected at 6, 15, 24 and 36 months, and was determined by a family's total income and the household size. The higher the score, the more financial resources a family had.

Data analytic plan

Data were analyzed using Structural Equation Modeling (SEM) in Mplus 8 with maximum likelihood estimation. Missing data were addressed using the Full Information Maximum Likelihood (FIML) estimation. A bootstrap approach was applied to test an effect of mediation. Bootstrap is a nonparametric resampling method, which combines the cases in the sample in different ways to generate "new" data sets, e.g., some cases appear twice and some cases are omitted (Shrout & Bolger, 2002). Parameters are estimated across those "new" datasets, from which an empirical sampling distribution is created. The empirical sampling distribution provides confidence intervals (CI) of estimates (Shrout & Bolger, 2002). If zero does not fall within the CI, it suggests that an indirect effect is different from zero, and, therefore, is present, but if zero falls within the CI, it suggests that an indirect effect is not different from zero and is not present. A bias-corrected bootstrap with 1000 resamples was drawn to derive the 95% CIs for the indirect effect of parenting on working memory through attentional shifting and attentional focusing.

Results

Descriptive statistics and correlations are presented in Tables 1 and 2. We tested (a) whether parenting at 6 months predicted working memory at 36 months, through attentional focusing and attentional shifting at 24 months, after controlling for parenting and family income at 24



Table 2. Correlations.

	1	2	3	4	5	6	7	8
1.Parenting at 6 m	_							
2.Parenting at 15 m	0.64	_						
3.Parenting at 24 m	0.56	0.65	_					
4.Parenting at 36 m	0.56	0.62	0.63	_				
5.Attentional focusing at 24 m	0.14	0.11	0.17	0.17	_			
6.Attentional shifting at 24 m	0.22	0.23	0.24	0.22	0.092	_		
7.Verbal WM at 36 m	0.16	0.24	0.24	0.25	0.12	0.16	_	
8.Income at 24 m	0.36	0.40	0.40	0.36	0.12	0.15	0.15	_
9.Income at 36 m	0.39	0.43	0.40	0.37	0.12	0.14	0.16	0.81

^{*}All ps < .001.

and 36 months; and, (b) whether parenting at 15 months predicted working memory at 36 months, through predicting attentional focusing and attentional shifting at 24 months, after controlling for parenting at 6, 24 and 36 months, and family income at 24 and 36 months.

The association between parenting, attention and working memory over time was examined in SEM. Estimation of the model yielded good global fit, $\chi^2 = 10.76$, df = 6, p= .09, RMSEA = 0.026, CFI = 0.976, TLI = 0.917, SRMR = 0.01. Unstandardized coefficients and SEs are shown in Table 3.

Standardized path coefficients are shown in Figure 2. There was a significant indirect effect of attentional shifting at 24 months on the association between parenting at 6 months and working memory at 36 months, after controlling for family income at 24 and 36 months and parenting at 36 months, 95% CI [0.003, 0.03], suggesting that parenting at 6 months predicted working memory at 36 months by predicting attentional shifting at 24 months. The indirect effect of parenting at 6 months on working memory at 36 months by predicting attentional focusing at 24 months, however, was absent, 95% CI [0.000, 0.02].

The indirect effect of parenting at 15 months on working memory at 36 months by influencing attentional shifting at 24 months was absent, 95% CI [-0.001, 0.032]. Additionally, the indirect effect of parenting at 15 months on working memory at 36 months via attentional focusing at 24 months was also absent, 95% CI [-0.020, 0.004]. However, parenting at 15 months was associated with working memory at 36 months, after

Table 3. Unstandardized coefficients and SEs of the structural equation model.

	Unstandardized coefficient	S.E.	t	р
Attentional focusing at 24 months				
Parenting at 6 months	0.07	0.04	1.78	.075
Parenting at 15 months	-0.05	0.05	-0.92	.357
Parenting at 24 months	0.13	0.04	3.09*	.02
Income at 24 months	0.02	0.02	1.27	.202
Attentional shifting at 24 months				
Parenting at 6 months	0.14	0.06	2.56**	.01
Parenting at 15 months	0.11	0.07	1.58	.114
Parenting at 24 months	0.15	0.05	2.78**	.005
Income at 24 months	0.02	0.17	0.94	.345
Verbal working memory at 36 months				
Parenting at 6 months	-0.08	0.06	-1.36	.175
Parenting at 15 months	0.18	0.06	2.87**	.004
Parenting at 36 months	0.20	0.06	3.61***	.000
Attentional focusing at 24 months	0.10	0.05	2.27*	.023
Attentional shifting at 24 months	0.10	0.032	3.09***	.002
Income at 36 months	0.035	0.021	1.65	.09

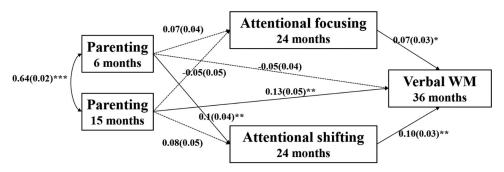


Figure 2. Statistical model: attentional shifting mediated the relationship between parenting and verbal working memory. Solid lines indicate significant associations, and dash lines indicate non-significant associations.

accounting for the effect of attentional shifting and attentional focusing at 24 months on working memory, unstandardized coefficient = 0.18, SE= 0.063, p= .004. The model explained a total of 9% variance in working memory.

Discussion

This study examined the mediating role of attentional focusing and attentional shifting on the relationship between parenting and working memory. Higher quality parenting at 6 months predicted greater attentional shifting at 24 months, which, in turn, predicted greater working memory at 36 months. Thus, parenting behaviors, as early as 6 months of age, were related to later working memory ability. Results also supported the proposal that improvements in attentional shifting may underlie the development of working memory, providing support for Miyake and colleagues' (Miyake et al., 2000) proposal that attention may serve as a mechanism underlying EF, even in early childhood.

Attentional shifting at 24 months did not mediate the association between parenting at 15 months and working memory at 36 months. The lack of a significant result despite a positive result for earlier parenting suggests that how parenting is related to working memory is dynamic, and other mechanisms may underlie this association, e.g., children's language ability (Matte-Gagné & Bernier, 2011). Note that the effect of parenting at 15 months was tested after controlling for parenting at 6 months; therefore, parenting at 15 months did not contribute to attentional shifting over and above parenting at 6 months.

Attentional shifting, but not attentional focusing, mediated the link between parenting and working memory. The working memory task asked children to repeat words in reverse order, which required children to switch attention between words and manipulate words in memory. Thus, attentional shifting, the ability to switch attentional focus between activities/ tasks, may be relied upon more heavily for this task. Additionally, previous research suggested that attentional focusing and attentional shifting may develop separately in young children (Garon et al., 2008; Posner, Sheese, Odludaş, & Tang, 2006). Jones and colleagues (Jones, Rothbart, & Posner, 2003) found that attentional focusing and attentional shifting were negatively related in children 3 to 4 years of age. They proposed that as the anterior attention system matures over childhood, attentional focusing and attentional shifting become integrated (Jones et al., 2003). In the current study, the correlation between

attention focusing and attention shifting was significantly positive, but the coefficient (i.e., 0.092) was low, suggesting that they may be separate processes in young children (Posner et al., 2006).

Attentional shifting was a significant mediator after controlling for attentional focusing, suggesting that attentional shifting at 24 months is more strongly, and uniquely, related to the early development of working memory. Future research should examine the developmental trajectories of attentional focusing, attentional shifting, and working memory to better elucidate the relationship between these processes (also see Garon et al., 2008). Future research should also consider cultural differences and whether these relationships remain across different cultures and parenting practices. Although parenting behaviors vary across cultures (Bornstein, 2012), research supports a cross-cultural association between warm, responsive and autonomy supportive parenting and positive developmental outcomes in children (Kelley, Smith, Green, Berndt, & Rogers, 1998; Querido, Warner, & Eyberg, 2002). Thus, sensitive and autonomy supportive parenting appears to be beneficial for development across cultures (Kelley et al., 1998).

Limitations

This study has a few limitations. First, children's attention is measured using parent report, instead of direct measures of attention such as behavioral tasks. Research suggests that parent report of attention is predictive of children's attention in multiple contexts (e.g., Rothbart, et al., 2000), but parental ratings of attention are also impacted by other factors such as parental attributions (Johnston & Freeman, 1997). Future studies should use multiple measures of attention, such as behavioral measures and/or both parent and teacher report, to better represent children's attentional control. Second, working memory was only measured once, so children's working memory at earlier time points could not be controlled in the model. Future research should test how parenting and attention are associated bidirectionally with changes in working memory over development.

Conclusions

This study provided evidence that parenting and attentional control are related to the development of working memory. Additionally, attentional shifting mediated the association between parenting and working memory in early childhood. The findings also corroborated the importance of sensitive, autonomy supportive and cognitive stimulating parenting early in life for a child's cognitive development.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are openly available in Inter-university Consortium for Political and Social Research at 10.3886/ICPSR34602.v4

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