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CHILD DEVELOPMENT PERSPECTIVES

Parenting Influences on Executive Function in Early Childhood: A Review

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ABSTRACT—***Developmental processes critical to the emergence of executive function (EF) play out across early childhood—a period of rapid change and neural plasticity. The emergence of self-regulatory capacities is highly embedded in the many contexts or ecologies nested within a child's broader environment, among which the parent–child relationship assumes primary importance. However, only recently have early childhood researchers begun to investigate the contributions of parenting variables to EF. In this article, we review this emerging evidence as it pertains to (a) the parenting behaviors associated with EF, (b) the risk and protective factors that moderate these associations, and (c) the mechanisms through which parenting apparently operates on emerging EF. We also discuss directions for research on transactional parent–child dynamics, experimental tests of causation, and differential susceptibility to environmental influences.***

KEYWORDS—*executive function; early childhood; parenting; inhibitory control; cognitive control*

The emergence of control over attention, cognition, and behavior is one of the core achievements of early development, and it underpins a range of developmental domains associated with academic achievement, socioemotional competence, and resilience (see Carlson, Zelazo, & Faja, 2013). The term *executive function* (EF) refers to the specific higher order processes (e.g., inhibitory control, cognitive flexibility or shifting, and working memory) that enable goal-directed action and adaptive responses to novel or ambiguous situations (Hughes, Graham, & Grayson, 2004). Early childhood is a key period to understand parenting influences on EF, because during this time, environmental experiences influence the development of related (prefrontal cortex) circuity (Kolb et al., 2012) and children are particularly dependent on caregivers for stimulation, nurturance, and regulation (Sameroff, 2010).

Extreme disturbances in caregiving (e.g., maltreatment) and other environmental insults are associated with deficits in EF early in life (e.g., Pechtel & Pizzagalli, 2011), but we know little about the influences of more common parenting processes on EF. In this article, we review this research as it pertains to three questions: (a) Is quality of parenting associated with early childhood EF? (b) What risk or protective factors moderate associations between parenting and EF?, and (c) Through what mechanisms does parenting operate on EF across early childhood?

THEORETICAL PERSPECTIVES ON PARENTING AND EF

Researchers are only beginning to develop models of EF that reflect an ecological perspective on child development. In so doing, they are starting to recognize that EF represents a constellation of processes that emerge as the output of many neural systems, and that plasticity in these systems is greatest early in life (e.g., Diamond, 2013). In contrast to prior models of EF that have focused on either genetic factors (biological maturation theory; Friedman et al., 2008) or socialization processes (sociocultural theory; Lewis & Carpendale, 2009), emerging ecological models assume that EF is embedded within a combination of multilevel biological and contextual processes (Zelazo, 2013).

Parenting behaviors most consistently associated with individual differences in EF can be grouped into four theoretically derived dimensions (Landry & Smith, 2010; O'Connor, 2002): (a) scaffolding, (b) stimulation, (c) sensitivity/responsiveness versus hostility/rejection, and (d) control. As emphasized in sociocultural theories, parental scaffolding (e.g., verbal or physical

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guidance) involves deliberate efforts by parents using either verbal or nonverbal actions to help children engage with a challenging activity (Lewis & Carpendale, 2009). This classification also includes autonomy support or granting parents' encouragement of children's opinions, choices, decisions, and problem solving (Matte-Gagne & Bernier, 2011).

Parental stimulation involves providing children with opportunities to develop cognitive skills through enriched interactions including reading to children (Bradley, McKelvey, & Whiteside-Mansell, 2011). As conceptualized in attachment theory, sensitive/responsive caregiving (e.g., positive effect, warmth, absence of hostility) is assumed to promote the internalization of regulatory strategies (Bernier, Carlson, Deschenes, & Matte-Gagne, 2012). Hostility/conflict or rejection is defined by affective behaviors with a negative, critical, or rejecting tone (e.g., negative effect, intrusiveness) and consistent with the studies discussed here, is often viewed as the opposite of the sensitive/responsive caregiving dimension (O'Connor, 2002). Finally, social-cognitive theories posit that children's regulatory capacities may be promoted through supportive behavioral control or discipline (e.g., authoritative) or undermined by negative control (e.g., harsh discipline; Grolnick & Pomerantz, 2009).

KEY VARIABLES AND DEFINITIONS

In this review, we focus on studies that include (a) a direct measure of parenting toward a target child, as defined later; (b) a discrete measure of children's EF, as opposed to overlapping temperament-based constructs including effortful control; (c) data on associations between parenting and children's EF variables; and (d) participants from 2 to 6 years (± 6 months). Despite much research into the effects of environmental factors on the development of EF, we do not understand the effects that can be attributed to parenting per se. Contexts of extreme adversity may be characterized not only by compromised caregiving but also a range of other environmental insults (e.g., maltreatment) that likely also shape EF (Pechtel & Pizzagalli, 2011). Likewise, several neurodevelopmental disorders and conditions (e.g., attention deficit hyperactivity disorder [ADHD], prematurity) are characterized by deficits in EF that emerge somewhat independently of parenting. To draw interpretations about the specific contributions of parenting to the development of EF in this review, we excluded studies of children with neurodevelopmental conditions and from adverse contexts (e.g., homelessness, maltreatment).

Researchers have defined EF as a centralized unitary construct, a construct with many components, or a unitary construct with dissociable components (e.g., Garon, Bryson, & Smith, 2008; Wiebe et al., 2011). Although researchers agree that the subcomponents of EF differentiate increasingly with age, we lack consistent evidence about the structure of EF in early childhood (e.g., Miller, Giesbrecht, Müller, McInerney, & Kerns, 2012; Willoughby, Pek, Blair, & Family Life Project, 2013). In our review, we consider all existing EF constructs as operationalized within specific studies. For example, some of the paradigms used to operationalize EF in the studies we reviewed index inhibitory control, while others are tailored toward working memory and cognitive flexibility, each of which may vary in the extent to which they reflect the latent construct of EF in early childhood (for discussions of task impurity, see Anderson & Reidy, 2012; Miller et al., 2012). Given that components of EF (e.g., working memory) and general intelligence are often correlated, researchers have often controlled for intelligence (or verbal ability) in analyses of the relation between EF and various correlates. On the basis of the findings from such research, we now recognize that EF contributes to child development independent of general intelligence and other covariates, including socioeconomic status (SES; e.g., Blair et al., 2011).

The measures of parenting included in this review encompass observations, questionnaires, and interviews, specifying caregiver behaviors that are directed toward a specific child (e.g., stimulation), as opposed to parents' personal characteristics (e.g., maternal depression; O'Connor, 2002) or attitudes toward parenting. Following a search strategy (described in Supplementary Document Data S1, available online), studies meeting these criteria were examined in relation to our three core questions. We classify parenting variables according to study authors' definitions and their best fit within the four parenting dimensions outlined earlier. See Table S1 (included in Supplementary Document Data S1, available online) for a list of study characteristics, measures, and key variables (including covariates).

IS QUALITY OF PARENTING ASSOCIATED WITH EARLY CHILDHOOD EF?

Parental Scaffolding and EF

In five longitudinal studies, scaffolding predicted prospective development across a range of EF domains. In research on contexts in which parents interacted with their children during a problem-solving task, higher levels of EF in children entailing working memory and cognitive flexibility tasks were associated with greater maternal autonomy support (Bernier, Carlson, & Whipple, 2010; Matte-Gagne & Bernier, 2011), verbal and physical prompting (Hammond, Müller, Carpendale, Bibok, & Liebermann-Finestone, 2012), scaffolding—including praise and elaboration (Hughes & Ensor, 2009), and maternal behaviors that maintained and redirected children's attention (Conway & Stifter, 2012). Parental scaffolding remained significantly related to EF when controlling for children's language and prior EF (Bernier et al., 2010; Hammond et al., 2012; Hughes & Ensor, 2009). Imitative learning (via maternal planning) was also associated with later EF, albeit more modestly (Hughes & Ensor, 2009). In two cross-sectional studies in which children performed structured problem-solving tasks, parents' elaborative utterances (Bibok, Carpendale, & Müller, 2009) and a more global measure of scaffolding associated positively with cognitive

flexibility at age 2 and inhibitory control at age 4 (Bibok et al., 2009; Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013).

Parent–child processes underlying parental scaffolding have been among the most broadly described putative mechanisms, and influence early EF development more immediately or proximally than parent behaviors that are less explicitly focused on children's learning (Hughes & Ensor, 2009; Matte-Gagne & Bernier, 2011). One study examined the relation between the timing of parental scaffolding in the context of children's puzzle-solving activities, finding that scaffolding predicted children's attention-switching EF, even after controlling for children's verbal language (Bibok et al., 2009).

Parental Stimulation and EF

Four longitudinal and two cross-sectional studies examined associations between parental stimulation and EF in early childhood. Parental stimulation, as indexed by the Home Observation for Measurement of the Environment (Bradley et al., 2011), has been associated prospectively with sustained growth in inhibitory control and cognitive flexibility (controlling for baseline EF; Clark et al., 2013), increased attentional control (Mezzacappa, Buckner, & Earls, 2011), and sustained attention, impulsivity, working memory, and planning (Hackman, 2012). Furthermore, in a reanalysis of data (National Institute of Child Health and Human Development [NICHD], 2005) indicating that a combination of parental stimulation and sensitivity in infancy and early childhood predicted attention and memory performance (not planning) in first grade, parental stimulation during early childhood (not infancy) partially mediated the adverse effects of low SES on all components of EF at age 4 1/2 (Hackman, 2012). Results from cross-sectional studies of stimulation and EF have been mixed: In one, parental stimulation (based on parents' reports) was unrelated to EF (Blankson, O'Brien, Leerkes, Marcovitch, & Calkins, 2011), while in another, an association between stimulation and EF became insignificant after verbal ability was considered (Dilworth-Bart, 2012).

Parental Sensitivity (vs. Hostility) and EF

Ten studies reported empirical evidence for the effects of sensitivity/hostility on EF: In five longitudinal studies (two pairs of studies used the same data set), EF in early childhood was associated with maternal sensitivity in four (Blair et al., 2011; Hackman, 2012; NICHD, 2005; Rhoades, Greenberg, Lanza, & Blair, 2011). In one study, both maternal sensitivity and hostility predicted EF (Blair et al., 2011), while in another, only hostility predicted EF (Holochwost, 2013). In the study mentioned earlier, maternal sensitivity during early childhood related uniquely to EF planning (not working memory, attention, or impulsivity; Hackman, 2012).

Prospective EF has also been associated with sensitivity during infancy, across diverse observational paradigms (Cuevas et al., 2014; Kraybill & Bell, 2013). In a follow-up study, parent–child attachment security predicted 3-year EF conflict more strongly than sensitive caregiving per se (i.e., parental mentalizations, autonomy support, sensitivity; Bernier et al., 2012). Cross-sectional evidence has been mixed: In one study, hostility correlated negatively with EF (Hopkins et al., 2013), while in another, positive parenting did not relate significantly to EF once verbal ability was considered (Hughes & Ensor, 2005). To clarify the influences of parental sensitivity and hostility on early childhood EF, researchers may have to adopt coordinated approaches to measuring parenting variables and early childhood EF, which vary across studies.

Parental Behavioral Control/Discipline and EF

The few studies that have examined associations between early childhood EF and dimensions of parental control have yielded mixed conclusions. In two longitudinal studies, lower levels of parental control were related positively to children's EF 2–3 years later (Bindman, Hindman, Bowles, & Morrison, 2013; Roskam, Meunier, Stievenart, & Noel, 2013). In contrast, in another study, self-reported parental disciplinary practices were unrelated to EF (both hot and cool tasks; Weber, 2011). These studies did not control for IQ-related covariates and they relied largely on self-report parenting data (see Table S1 available online).

ARE ASSOCIATIONS BETWEEN PARENTING AND EF MODERATED BY OTHER RISK/PROTECTIVE FACTORS?

A number of studies have tested the possibility that additional variables may moderate associations between parenting and EF in early childhood. Among those implicated in such effects are ethnicity (Holochwost, 2013; Rhoades et al., 2011), gender (Clark et al., 2013), temperament (Blankson et al., 2011; Conway & Stifter, 2012), physiological indices of self-regulation (i.e., indices of sympathetic, parasympathetic, and cortisol stress systems; Holochwost, 2013), and prenatal cigarette exposure (Mezzacappa et al., 2011).

To illustrate, negative parenting was associated less proximally with EF in African American children than in White children (Rhoades et al., 2011). Male gender and low social support interacted to result in lower EF (cognitive flexibility; Clark et al., 2013). Children's temperament moderated the association between parenting and EF (Conway & Stifter, 2012), and EF and children's vocabulary (Blankson et al., 2011). Parental scaffolding (attention maintaining) influenced inhibited and exuberant children more strongly than low-reactive children (Conway & Stifter, 2012), while shy children exposed to high stimulation had lower EF than their less shy peers (Blankson et al., 2011). Physiological self-regulation moderated the effects of negative intrusiveness on children's EF, but only within a subset of children characterized by a more mature physiological self-regulation (Holochwost, 2013). Parental stimulation mitigated the adverse effects of cigarette exposure on children's executive

attention (Mezzacappa et al., 2011). These findings suggest that the developmental processes that underpin the early emergence of EF involve complex interactions between children's characteristics and environmental inputs.

WHAT ARE THE MECHANISMS THROUGH WHICH PARENTING OPERATES ON EF?

Only four studies used mediation analyses to investigate the processes through which parenting variables may produce change in EF across early childhood. Consistent with the notion that children's language facilitates self-reflection and active control of impulsive responses (Landry & Smith, 2010), three studies suggest that the effects of parental scaffolding, sensitivity, and stimulation on children's EF can be accounted for, in part, by changes in children's language capacities (Clark et al., 2013; Hammond et al., 2012; Matte-Gagne & Bernier, 2011). In one study, physical and verbal prompting predicted EF indirectly at age 4 through verbal ability at age 3 (Hammond et al., 2012). Similarly, children's expressive vocabulary at age 2 mediated higher EF (entailing impulse-control tasks of delayed gratification) at age 3 (Matte-Gagne & Bernier, 2011). And deficits in EF among children whose parents did not provide a stimulating environment were accounted for, in part, by deficits in language capacity (naming colors) and processing speed (Clark et al., 2013).

Biological mechanisms involving the hypothalamic-pituitary-adrenal (HPA) axis have also been implicated. Concentrations of cortisol, a glucocorticoid hormone that modulates activity in the prefrontal cortex, partially mediated the association between positive parental support and prospective EF across the infant and toddler years (Blair et al., 2011). As such, highly supportive environments apparently result in lower levels of cortisol, which in turn account for increases in children's EF over time. This finding may support the idea that early childhood EF develops, in part, through mechanisms that are consistent with theories of biological sensitivity (Blair et al., 2011).

In recent years, researchers have progressed considerably in investigating the contributions of parenting to the development of EF across early childhood. Notwithstanding the inconsistencies that have at times characterized findings, studies of parenting and EF will inform developmental perspectives on self-regulation, supplementing findings from related fields, notably research into temperament (e.g., effortful control) and emotion regulation. Early caregiving influences including parental responsiveness (Kochanska, Murray, & Harlan, 2000), maternal warmth (e.g., Spinrad et al., 2007), and parental discipline (e.g., Olson et al., 2011) have been associated with individual differences in effortful control. However, in contrast to the evidence on EF reviewed here, research has produced discrepant findings regarding the influence of parental teaching on children's effortful control (Eisenberg et al., 2010; Lunkenheimer, Kemp, & Albrecht, 2013). A more fine-grained approach to studying the dissociable components of effortful control and EF in relation to parenting processes may be needed to integrate findings across these fields (e.g., Graziano, Keane, & Calkins, 2010; Karreman, van Tuijl, van Aken, & Dekovic, 2006).

LOOKING AHEAD

The findings in this review suggest four directions for research. First, researchers need to understand more fully the role of transactional parent–child dynamics in the early emergence of EF. Individual differences in parental sensitivity are shaped, in part, by child-driven effects from attention control (Belsky, Fearon, & Bell, 2007), but such evidence is limited. Research based on many levels of analysis is needed to characterize more completely such processes and their role in the complex developmental cascades in which EF is likely to play a role across early development (see Bornstein, Hahn, & Wolke, 2013). Only three of the studies we reviewed (Bernier et al., 2012; Hopkins et al., 2013; Roskam et al., 2013) included fathers; researchers need to examine both maternal and paternal behaviors and risks (e.g., maternal depression; Ensor, Roman, Hart, & Hughes, 2012), particularly in light of studies indicating that each may contribute differentially to a range of children's outcomes (e.g., Yates, Obradovic, & Egeland, 2010).

Second, as in many other fields of developmental psychology, evidence on the influences of parenting on EF is correlational. Demonstrating that parenting variables are associated with individual differences in EF is different from demonstrating that change in a specific parenting variable has a causal effect. Based on studies suggesting that EF is amenable to intervention (Bierman & Torres, in press; Diamond & Lee, 2011), researchers should conduct experimental tests of specific causal mechanisms through parenting interventions in the early childhood years. Such evidence may help us understand the contributions of parenting to the distinct versus overlapping processes that underpin EF and effortful control, and inform a unified theoretical framework to encompass both constructs (Liew, 2012; Zhou, Chen, & Main, 2012).

Third, the influences of parenting on EF do not operate equally across all children. Children's temperament, gender, and ethnicity apparently moderate the influences of parenting on EF across early childhood. Interactive effects of this kind may reflect differential susceptibility to environmental influences on EF and warrant investigation in relation to the predictions of emerging models in developmental psychopathology (Belsky & Pluess, 2009). The genetically informed study designs that have advanced family models of ADHD may contribute valuable evidence to models of EF (Harold et al., 2013). Likewise, models in the field may benefit from the adoption of more domain-specific and coordinated approaches to the measurement and conceptualization of parenting, which vary across studies (Grusec & Davidov, 2010; O'Connor, 2002).

Finally, researchers need to characterize more effectively the structure of EF in early childhood. Consistent with existing

developmental models, the studies reviewed here used paradigms focused on inhibitory control and cognitive flexibility more frequently than those focused on the working memory or planning skills that are more commonly investigated at older ages (e.g., Doan & Evans, 2011). Challenges associated with developmentally specific conceptualization and measurement limit the potential to examine early parenting influences on a broader range of processes. As such, progress in this conceptualization and measurement will continue to inform research into the parenting influences addressed here.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Data S1. Systematic Review Methodology

Table S1. Characteristics of Included Studies