Aggression in infancy and toddlerhood: the roles of prenatal risk, parenting behavior and cognition

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GENERAL INTRODUCTION

Chapter 1

Antisocial behavior during adolescence or early adulthood not seldom reflects a continuation of a behavioral pattern of externalizing behavior problems already present during early childhood (Bongers, Koot, van der Ende, & Verhulst, 2004). High and persistent levels of aggression during early childhood are associated with an increased risk of negative developmental outcomes, such as school drop-out, problems in academic achievement, social problems, delinquency and internalizing behavior problems during school age and early adolescence (Brennan, Shaw, Dishion, & Wilson, 2012; Broidy et al., 2003; Campbell, Spieker, Burchinal, & Poe, 2006; Mesman, Bongers, & Koot, 2001). Antisocial behavior and related developmental outcomes evidently have a large societal impact (Gielen & Akkermans, 2019; Hoeffler, 2017; McCollister, French, & Fang, 2010; Moolenaar, Vlemmings, van Tulder, & de Winter, 2019). Therefore, early detection of high and persistent levels of aggression and preventive intervention of negative developmental impact are considered important.

Whereas interventions during late childhood or early adolescence aiming at reduction of externalizing behavior problems show limited effects, better results have been obtained with early-life interventions (Fossum, Handegard, Adolfsen, Vis, & Wynn, 2016). Therefore, it is important to identify children showing high levels of externalizing behavior problems as early as possible so that interventions can be applied in time. Gaining a better understanding about early mechanisms related to the development of aggressive behavior during the first years of life is essential for developing effective intervention programs to prevent negative developmental outcomes.

Several studies have shown that many children are born with a specific 'difficult' temperament or are exposed to prenatal, perinatal or postnatal (environmental) risk factors, such as use of alcohol, drugs of nicotine during pregnancy, birth complications, or adverse parenting behavior, that might predispose them to the development of aggressive behavior (Campbell, Shaw, & Gilliom, 2000; Dodge & Pettit, 2003; LaPrairie, Schechter, Robinson, & Brennan, 2011; van Goozen, Fairchild, Snoek, & Harold, 2007). Several cognitive functions, contributing to the so-called self-regulatory processes which are important for adaptively modulating behavior to the environment (Calkins & Keane, 2009), are considered important intermediate factors in associations between temperament and adversity on the one hand and aggressive behavior on the other hand. These cognitive functions might play both mediating and moderating roles in the risk for developmental impact of environmental adversity and the effect of temperament. Specific impairments in cognition have been proposed as mechanisms through which negative environmental influences lead to aggressive behavior (Beauchamp & Anderson, 2010; Dodge & Pettit, 2003). For example, the presence of several (prenatal) environmental risk factors, such as low maternal education and maternal psychopathology, was shown to be associated with impairments in cognitive functioning, including executive functioning, which, in turn, was shown to be predictive of externalizing behavior problems (Hughes & Ensor, 2009; Roman, Ensor, & Hughes, 2016). Impairments in cognition also appear to be

associated with an increase in vulnerability for aggressive behavior in case of adverse environmental influences and a difficult temperament, illustrating the interaction between risk factors (Masten, 2001; Muris & Ollendick, 2005). For example, high environmental risk and high temperamental reactivity were related to higher levels of (externalizing) behavior problems in childhood, but only in children showing impairments in cognitive functioning (Lengua, 2002; Moran, Lengua, & Zalewski, 2013).

Although the factors prenatal risk, parenting behavior, temperament and cognitive functions have consistently been related to externalizing behavior problems during preschool and school age (Carneiro, Dias, & Soares, 2016; LaPrairie et al., 2011; Olson, Lopez-Duran, Lunkenheimer, Chang, & Sameroff, 2011; Petersen et al., 2013; Sanson, Hemphill, & Smart, 2004; Schoemaker, Mulder, Dekovic, & Matthys, 2013), research focusing on their interplay in relation to aggressive behavior during the first years of life is scarce. Therefore, the aim of this dissertation is to examine the associations between prenatal risk, parenting behavior, temperament, and cognitive development in predicting aggressive behavior, focusing on infancy and toddlerhood.

Early development of aggressive behavior

Aggressive behavior, within the meaning of a behavioral response resulting from frustration, hunger of threat (Buss & Shackelford, 1997), is part of typical development and is frequently seen already in infancy (the age range from birth to one year old) as well as during toddlerhood (the age range from one to three years old). Generally, aggression refers to an unfavourable form of social behavior with the (intentional) effect to harming people (Buss, 1961). Harmful intent however is very unlikely to play a role in early expressions of aggression (Gendreau & Archer, 2005). From an evolutionary perspective, aggressive behavior is considered to be 'adaptive' to adverse conditions or circumstances: humans are genetically programmed to be able to use 'aggressive' behavior, among other things, to react to frustration, hunger or threat (Buss & Shackelford, 1997), showing an adaptive response to a situation that needs to be alleviated, which may be the effect of the 'aggressive' response (e.g. crying, hitting, biting) that is merely an expression of discomfort at a very young age without intention to harm. Also, during infancy and toddlerhood, the inability to express discomfort in different ways (like verbally) plays a role in the emergence of aggressive behavior.

The first expressions of aggressive behavior that can be observed generally involve behaviors such as biting and hitting (Hay, 2017). Such behaviors can be seen during the first year of life, as soon as children have the motor skills to use force (Hay et al., 2010). During infancy and toddlerhood, the level of physical aggression increases until it peaks at around two years of age (Alink et al., 2006; Nærde, Ogden, Janson, & Zachrisson, 2014). At the same time, this behavior is regulated by developmental processes like the increasing ability to realize the impact of one's behavior on other people, associated with the ability to feel empathy (Hughes & Leekam, 2004). In the following years, the level of aggressive behavior typically starts declining. From

toddlerhood onwards, aggressive behavior will include different aspects of aggression, such as disruptive behavior, oppositional defiant behavior, and verbal aggression, and will gradually transform to more intentional aggressive behavior (Hay et al., 2011; Tremblay et al., 1999), associated with ongoing development of social and communicative skills.

However, not all children follow this rather common developmental pattern of aggressive behavior. Indeed, longitudinal studies examining trajectories of aggressive behavior indicated several distinct developmental patterns during childhood (Bongers et al., 2004; Broidy et al., 2003; Olson, Choe, & Sameroff, 2017). Most of the studies examining trajectories of aggression starting during the second year of life indicated three different trajectories of physical aggression from 1.5 years until preschool (Huijbregts, Séguin, Zoccolillo, Boivin, & Tremblay, 2008; Mazza et al., 2017; Tremblay et al., 2004; Wildeboer et al., 2015). The three most frequently identified trajectory shapes are a low-stable trajectory in 25 to 32% of the children, a moderately increasing or stable pattern in 50 to 58% of the children, and a high increasing or stable pattern in 14 to 25% of children.

The studies indicating distinct developmental trajectories stress the importance of taking a developmental perspective in examining aggressive behavior during early childhood. Previous studies mainly focused on the development of aggressive behavior during toddlerhood, preschool or school age. Although the first signs of aggression were shown to occur during infancy (Hay, 2017), not much is known about the first year of life. More research is needed to unravel whether the developmental patterns of aggressive behavior observed from toddlerhood onwards are already present in infancy. Therefore, this dissertation concentrates on the developmental patterns of aggressive behavior from infancy into toddlerhood.

Environmental influences

Since the first years of life are known as a very critical or sensitive period for children's development, early experiences have a large influence on children's behavioral development (Fox & Rutter, 2010; Huizink & de Rooij, 2018). The influence of adverse environmental factors on developmental outcomes results from the interaction with children's brain development (Beauchamp & Anderson, 2010). The individual's psychophysiological systems are adapted to be able to cope with stressful environmental situations, a biological mechanism defined as allostasis (Juster et al., 2011; Sterling, 2012). When exposure to adverse environmental influences becomes intense by repeated or prolonged adversity, these adaptive systems might become dysregulated. This will have an adverse and lasting impact on the brain and body, such as prolonged alterations in the individual's stress hormone levels, and structural, functional and neurochemical changes in brain areas involved in processing emotions, such as the amygdala, hippocampus and prefrontal cortex (Ganzel, Morris, & Wethington, 2010; McEwen, 2000), resulting in dysfunctional coping with

environmental challenges. In turn, these alterations could lead to psychopathology, such as high levels of aggressive behavior (Juster et al., 2011).

Numerous environmental influences, such as adverse parenting behavior, will impact behavioral development after the child has been born. Other environmental risk factors, such as use of alcohol, drugs of nicotine during pregnancy or maternal psychopathology, can affect brain development already prenatally or pose a continued risk after birth whilst already present prenatally (LaPrairie et al., 2011). Because both prenatal and postnatal factors influence children's behavioral development, this dissertation includes studies that evaluate the influence of aspects of both prenatal risk and parenting behavior.

Prenatal risk. Studies so far reported several pre- and perinatal risk factors that impact children's behavioral development (LaPrairie et al., 2011). Risk factors that have been linked to externalizing behavior problems and aggression during early childhood include parental psychopathology, prenatal alcohol, drug, and tobacco use, low level of maternal education, young maternal age and being a single parent (Carneiro et al., 2016; Côté et al., 2007; de Bruijn, van Bakel, & van Baar, 2009; Garratt, Chandola, Purdam, & Wood, 2017; Huijbregts et al., 2008; LaGasse et al., 2012; Latimer et al., 2012; Tremblay et al., 2004; Velders et al., 2011). These risk factors rarely appear in isolation, but often tend to co-occur (Carneiro et al., 2016). In addition, exposure to combinations of risk factors relative to a single risk factor was shown to enlarge their negative effects on developmental outcomes (Evans, Li, & Whipple, 2013; Huijbregts et al., 2008).These findings emphasize the importance of examining the accumulation of risk factors instead of the nature or intensity of single risk factors in relation to child behavior. Studies using a cumulative risk index (an index based on the number of risk factors) demonstrated that children who have been exposed to a higher number of maternal and environmental risk factors at birth or during early childhood, showed higher levels of externalizing behavior problems (Bennett, Marini, Berzenski, Carmody, & Lewis, 2013; Calkins, Blandon, Williford, & Keane, 2007; Gassman-Pines & Yoshikawa, 2006; Northerner, Trentacosta, & McLear, 2016; Trentacosta et al., 2008). Most studies so far examined exposure to risk factors during postnatal development. The current study aims to examine the effect of prenatal risk using a cumulative risk index on aggressive behavior during infancy and toddlerhood.

Parenting behavior and parental beliefs. Child behavior is influenced by social interactions from birth onwards. For example, low-quality child care, peer rejection and a negative sibling-relationship are related to more externalizing behavior problems (McCartney et al., 2010; Meunier et al., 2011). Because children highly depend on, and mostly interact with their parents during the first years of life, parents may have the largest impact on children's behavioral development early in life (Pinquart, 2017). When parents try to control children's behavior problems by using parenting behavior characterized by a lack of warmth, a lack of responsiveness or harsh caregiving, this can lead to increased risk of behavior problems in children (Patterson,

1986, 2002). Many studies show associations between both low maternal sensitivity (which is the ability to detect and adequately respond to their child's signals) and high maternal hostility, and higher levels of child aggressive behavior (Campbell et al., 2010; Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; McKee, Colletti, Rakow, Jones, & Forehand, 2008).

In addition to parenting behavior, parents' subjective beliefs about parenting may have an impact on children's social behavior. Two relevant aspects of parental beliefs are parental self-efficacy (i.e., parents' perceptions of their ability to carry out caregiving tasks successfully) and perceived parental impact (i.e., parents' views on the impact of their own parenting behavior on their children's development; Boivin et al., 2005). Parental beliefs may influence children's social behavior directly: because parents serve as a role model, children may adopt their parent's beliefs and attitudes, independent of parent's behavior during caregiving situations (Ardelt & Eccles, 2001; Bandura, 1997). In addition to this direct influence, parental beliefs may have an indirect effect on children's social development via parenting behavior (Jones & Prinz, 2005). Parents with higher parental self-efficacy or with the strong belief that their behavior will have an impact on their child's development, will be more motivated to interact positively with their child and to engage in activities that foster their child's cognitive development (Sigel & Mc Gillicuddy-De Lisi, 2002). In line with the direct pathway, research showed that low maternal self-efficacy and perceived parental impact are related to high stable levels of child aggression during toddlerhood and preschool (Côté et al., 2007; Mazza et al., 2017). Research examining the indirect pathway from parental beliefs to child problem behavior via parenting behavior is scarce. One study indicated that low parental self-efficacy was related to lower parental warmth and more hostility, which in turn were related to more problem behavior during toddlerhood (Zimmer-Gembeck & Thomas, 2010). Considering the increasing evidence for an important role of parental beliefs in development of aggressive behavior, and because parental beliefs evidently influence parenting (and potentially the chances of improving parenting skills through interventions), parental beliefs and parenting in relation to aggression should be studied in conjunction. This is what is done in the present thesis and to hopefully be of added value to future studies and interventions involving parenting.

Temperamental negative affect

Temperament refers to the initial 'state' from which personality develops (Rothbart, 2007). Temperament is defined as the make-up of several biological traits that, for a large part, determine reactivity and regulation of emotions and behavior (McCrae et al., 2000; Rothbart & Bates, 2006), and play an important role in children's social development (Sanson et al., 2004). One of the main reactive components of temperament is negative affect, which includes the tendency to experience and express negative emotions, such as sadness, frustration and anger (Rothbart & Bates, 2006; Sanson & Rothbart, 1995). These specific aspects of negative affect, as well as negative

affect in general, have been related to the development of psychopathology, including externalizing behavior problems, during early childhood (De Pauw & Mervielde, 2010; DeLisi & Vaughn, 2014; Frick, 2004; Muris & Ollendick, 2005).

In addition to the direct impact on aggressive behavior, a highly reactive temperament is also thought to increase the vulnerability for psychopathology in case of negative environmental influences (Monroe & Simons, 1991; Nigg, 2006). The diathesis-stress model suggests that individuals vary in whether and how much they are negatively affected by environmental stressors based on their individual neurobiological characteristics. This model has been supported by studies showing that parenting behavior characterized by high negative discipline and low sensitivity is related to more externalizing behavior problems, but only in children with high negative affect (Bradley & Corwyn, 2008; Van Zeijl et al., 2007). Results from studies examining environmental risk factors in interaction with negative affect are not consistent. It was found that higher risk was associated with problems in emotion regulation during preschool and lower social competence during preschool, but only in children high in negative affect during toddlerhood (Chang, Shelleby, Cheong, & Shaw, 2012). However, other studies did not find an interaction effect between the number of risk factors and negative affect (Lengua, 2002; Northerner et al., 2016). These inconsistencies in the literature might be due to differences in the examined outcome measures, such as externalizing behavior problems or broader domains of social functioning. This study examines the relation between negative affect and aggressive behavior during toddlerhood and investigates whether negative affect increases the vulnerability for aggression in case of high risk.

Cognition

In addition to negative affect, which is the reactive component of temperament, processes of self-regulation, such as aspects of cognitive functioning also shape the development of social behavior (Rothbart, Ahadi, & Evans, 2000). It has consistently been shown that children's cognitive regulation abilities, including inhibitory control and attention, are important for adequate social functioning (Beauchamp & Anderson, 2010), whereas delays in cognitive development have been related to inadequate social functioning, and specifically higher levels of aggression and externalizing behavior problems (Chow & Wehby, 2018; Girard et al., 2014; Schoemaker et al., 2013). In addition, cognitive functions represent important mechanisms in associations between biological and environmental factors, on the one hand, and social behavior, on the other (Beauchamp & Anderson, 2010; Dodge & Pettit, 2003). In this dissertation, four domains of cognitive functioning that play a role in regulating behavior were examined during infancy and toddlerhood: executive functions, attention, language skills and social cognition.

Executive functions. Executive functions are cognitive processes important for regulating behavior and emotions in a goal-directed way to adapt to the social environment, especially in case of new problems or situations. Inhibitory control is one

of the first executive functions to develop and may be defined as the ability to suppress a prepotent or dominant response (Garon, Bryson, & Smith, 2008; Miyake et al., 2000). The first signs of inhibitory control are already seen during the first year of life: 8- to 10-month-old infants are able to suppress the tendency to touch an attractive object when asked by the parent (Kochanska, Tjebkes, & Forman, 1998). Inhibitory control develops rapidly in toddlerhood and the preschool years, as indicated by improvement in the abilities to wait longer periods of time for a (larger) reward and to follow arbitrary rules in conflict-tasks, in which the dominant motor or verbal responses should be suppressed in certain situations (Carlson, 2005; Kochanska, Murray, & Harlan, 2000). The ability to suppress impulses is an important process in order to inhibit inappropriate social behavior. In line with this, deficits in inhibitory control have consistently been related to more externalizing behavior problems, and particularly aggressive behavior, during preschool and school age (Ellis, Weiss, & Lochman, 2009; Olson et al., 2017; Schoemaker et al., 2013; Suurland et al., 2016).

Attention. A second domain of cognition involved in regulating behavior is attention, which includes the ability to orient to information and to focus attention in response to decisions about relevance of this information (Rothbart & Posner, 2001). Attention is largely directed by novelty of objects and events during the first months of life (Colombo, 2001). Towards the end of the first year, novelty becomes less important, resulting in more voluntary control of attention (Colombo, 2002). Children become better able to shift attention between objects and situations, and to focus attention for longer periods of time (Colombo, 2001; Ruff & Capozzoli, 2003). Sustained attention has been proposed as a necessary skill to be able to recognize and appropriately respond to social cues in interaction with others (Murphy, Laurie-Rose, Brinkman, & McNamara, 2007). Children with problems in maintaining attention will probably miss social signals, resulting in less social competence and higher levels of behavior problems. Several studies showed associations between impaired attention regulation and externalizing behavior problems during preschool and school age (Bellanti & Bierman, 2000; Towe-Goodman, Stifter, Coccia, Cox, & Investigat, 2011).

Language skills. Several aspects of communication, such as the use of gestures, the expression of affect, and receptive and expressive language skills (including vocabulary), are important for interaction with others (Beauchamp & Anderson, 2010). After the first half year of life, children are able to recognize their own name and start to link other sounds and words with objects and individuals (Delle Luche, Floccia, Granjon, & Nazzi, 2017; Gogate & Hollich, 2010). During the second half of the first year, infants start vocalizing, followed by babbling (Lee, Jhang, Chen, Relyea, & Oller, 2017) and by using gestures (Fusaro, Harris, & Pan, 2012; Tomasello, Carpenter, & Liszkowski, 2007). Subsequently, infants start to say their first words around their first birthday (Rose, Feldman, & Jankowski, 2009; Torola, Lehtihalmes, Heikkinen, Olsen, & Yliherva, 2012). From toddlerhood, children undergo a rapid development in the amount of words they can comprehend and produce (Dale & Goodman, 2005). In addition, they start combining words and using grammar during

this period (Szagun, Steinbrink, Franik, & Stumper, 2006). The studies in this dissertation focus on children's vocabulary during the first years of life. It has been suggested that children with a relatively poor vocabulary will be less able to interact with their parents and peers about their needs and desires, resulting in frustration and behavior problems (Keenan & Shaw, 1997). Consistent with this hypothesis, studies indicated associations between the extent to which children are able to comprehend and produce words and externalizing behavior problems, such as aggressive behavior, during early childhood (Estrem, 2005; Menting, van Lier, & Koot, 2011; Petersen et al., 2013).

Social cognition. Social cognition refers to the cognitive processes that support the perception and interpretation of social information as well as the tendency to respond, based on social decision making (Beaudoin & Beauchamp, 2020). Theory of mind is an important social-cognitive skill, which involves the ability to attribute mental states, such as, thoughts, beliefs, intentions and desires, to oneself and others (Premack & Woodruff, 1978). Traditionally, it was thought that the ability to make explicit inferences about mental states of others develops during the preschool years (Wellman, Cross, & Watson, 2001). However, the implicit understanding of beliefs, desires and intentions has been observed earlier in life: children were able to attribute false beliefs about locations and identity during the second year of life (Baillargeon, Scott, & He, 2010).

Several social-cognitive skills during infancy and toddlerhood may be considered precursors of theory of mind, which could set the base for theory of mind development. These skills include for example the ability of children to recognize themselves in the mirror, to show empathic behaviors and to follow another person's attention (Charman et al., 2000; Gallup, 1998; Roth-Hanania, Davidoy, & Zahn-Waxler, 2011). These early skills of infants and toddlers indicate an innate predisposition to give attention to social information. Two other social-cognitive abilities that are considered precursors of theory of mind are the ability to imitate and to take the visual perspective of other people (Gopnik, Slaughter, & Meltzoff, 1994; Rogers & Pennington, 1991). The ability to imitate other people is already present in newborns, who show imitation of facial mimicry (Meltzoff & Moore, 1983). The "Like-me" framework of Meltzoff (2005) describes how children's inborn biological ability to imitate behavior is related to later understanding of other's mental states. As a first step, imitation indicates that children are at a certain age able to couple observed behavior and their own behavior. Based on their experiences in daily life and maturation of the brain, toddlers learn to link their behavior to their own underlying mental states. Understanding of other people's mental states develops when children are able to project their own mental states onto the other individual.

Another established precursor of theory of mind is visual perspective-taking (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004; Laranjo, Bernier, Meins, & Carlson, 2014). The ability to take another's visual perspective gradually develops into the ability to understand mental states of others. During the second year of life,

children first learn to recognize when another person does or does not see an object (Flavell, Everett, Croft, & Flavell, 1981; Liszkowski, Carpenter, Striano, & Tomasello, 2006) and that persons can observe the same object or situation differently from another perspective (Barnes-Holmes et al., 2004). Next, children become aware that someone's knowledge depends on his or her visual perspective. Finally, behavior of another person based on their knowledge can be predicted. Children's social cognition has been shown to be important for adequate social behavior: children who are less able to understand other's mental states and predict their behavior, will show less adequate social behavior (Baron-Cohen, Leslie, & Frith, 1985). A lack of theory of mind understanding has consistently been related to the development of psychopathology (Brune & Brune-Cohrs, 2006), including higher levels of aggressive behavior during preschool (Capage & Watson, 2001; Olson et al., 2011).

Cognition in relation to aggressive behavior in infancy and toddlerhood. Although the relations between cognitive regulating skills and externalizing behavior problems have extensively been studied, most studies focused on preschool or school age. Some evidence also exists for the relation between the cognition constructs and externalizing behavior problems earlier in life: low inhibitory control, inattention, and low vocabulary during the second year of life have been related to higher levels of externalizing behavior problems (Dionne, Tremblay, Boivin, Laplante, & Perusse, 2003; Girard et al., 2014; Hill, Degnan, Calkins, & Keane, 2006; Kochanska et al., 2000; Olson et al., 2011). Despite these findings, it should be noted that research into the relation between early cognition and externalizing behavior problems, and especially aggressive behavior, during infancy and toddlerhood is still scarce. Therefore, this dissertation focuses on the role of cognition during infancy and toddlerhood in an attempt to gain more understanding of the underlying early mechanisms associated with aggressive behavior.

Mediating and moderating role of cognition

Cognitive functions may serve as mechanisms explaining how the influence of environmental factors impacts on children's social behavior (Beauchamp & Anderson, 2010; Dodge & Pettit, 2003): for example, adverse environmental conditions may have a negative impact on brain development and cognitive functions related to regulating behavior, which in turn may result in higher levels of aggression. Consistent with this mediation model, previous studies showed that environmental influences such as high maternal risk and inadequate parenting behaviors are related to impairments in cognitive development during early childhood (Holochwost et al., 2016; Hughes & Ensor, 2005; Pavarini, Souza, & Hawk, 2013). Subsequently, relatively poor child cognition, such as low inhibitory control or theory of mind understanding, has consistently been related to externalizing behavior problems (Olson et al., 2011; Schoemaker et al., 2013). In line with these studies, some support for a mediating role of cognition was found during preschool: lower levels of children's executive functioning mediated the relation between maternal risk factors, such as depression

and low education, and externalizing behavior problems (Hughes & Ensor, 2009; Roman et al., 2016).

It has also been proposed that the impact of negative environmental influences (Masten, 2001) and temperamental reactivity on aggressive behavior (Muris & Ollendick, 2005) depends on children's cognitive regulation abilities. Higher levels of environmental risk or high negative affect may be related to higher levels of externalizing behavior problems, but only in children with limited cognitive abilities. With regard to environmental risk, several studies showed this moderating effect of specific cognitive functions when examining adverse parenting as environmental factor (Fatima & Sharif, 2017; Karreman, de Haas, van Tuijl, van Aken, & Dekovic, 2010; van Aken, Junger, Verhoeven, van Aken, & Dekovic, 2007). However, studies examining the moderating effect of cognition in infants' and toddlers' aggressive behavior in relation to the influence of other adverse environmental influences, such as prenatal risk factors, are scarce. One study indicated that the relation between environmental risk and a combined outcome of internalizing and externalizing behavior problems was strengthened in children with low cognitive skills, specifically inhibitory control and attention regulation (Lengua, 2002).

With regard to the interaction between (aspects of) temperamental negative affect and controlling cognitive functions, it has been proposed that children who experience high negative emotions (negative affect) elicited by life events are at risk to show aggressive behavior (Muris & Ollendick, 2005). Children with high levels of cognitive regulation skills, such as inhibitory control, attention and vocabulary, will be able to regulate the emotions using effective coping skills, while children with low cognitive regulation skills will have difficulties dealing with the negative emotions and may react with aggressive behavior. Findings of studies examining this hypothesis are not consistent. Several studies showed increased effects of (aspects of) negative affect on externalizing behavior problems, and specifically aggression, when children had lower inhibitory control, attention, or vocabulary during early childhood (Gartstein, Putnam, & Rothbart, 2012; Jackson, 2017; Lawson & Ruff, 2004; Moran et al., 2013; Suurland et al., 2016). However, other studies failed to find an interaction between negative affect and cognitive functioning on externalizing behavior problems during early development (Belsky, Friedman, & Hsieh, 2001; Gartstein et al., 2012; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005).

Although these studies suggest a mediating and moderating role of cognition in the relations between environmental influences and temperamental negative affect, on the one hand, and aggressive behavior on the other, it remains unclear whether these effects can already be observed during infancy and toddlerhood.

Aims and outline of this dissertation

Children who show persistently high levels of aggressive behavior during early childhood are supposed to be at risk for several adverse outcomes later in life. Although aggressive behavior is relative common during the first years of life, research

examining the development of aggression and its affective and cognitive correlates during infancy and toddlerhood is scarce. To be better able to prevent negative developmental outcomes related to aggression, it is important to learn more about the underlying mechanisms associated with the development of aggression during the first years of life. Therefore, the first aim of the current dissertation was to examine the developmental trajectories of aggressive behavior from infancy into toddlerhood. A second aim was to examine the associations between early cognitive functions, namely inhibitory control, attention, vocabulary, and precursors of theory of mind, and (the developmental trajectories of) aggression during infancy and toddlerhood. Furthermore, this dissertation aimed to increase insights into the mediating and moderating roles of specific (self-regulatory) aspects of cognition in associations between specific environmental influences, including prenatal risk and adverse parenting behavior, and aggression. The moderating role of cognition was also examined for associations between temperamental negative affect and aggression during infancy and toddlerhood.

The studies in this dissertation are part of the Mother-Infant Neurodevelopmental Study (MINDS) – Leiden in the Netherlands. MINDS-Leiden is a longitudinal study examining the neurobiological and neurocognitive predictors of behavior problems. 275 pregnant women between 17 and 25 years old, expecting their first child, participated in this study. The study consisted of six data waves: during the third trimester of pregnancy, and at 6 months, 12 months, 20 months, 30 months and 45-48 months post-partum. For the studies described in this dissertation, we were able to use data from the first five assessment waves.

Previous studies have mainly focused on the development of aggression from toddlerhood onwards (e.g. Campbell et al., 2006; Côté et al., 2006; Mazza et al., 2017). Chapter 2 describes a study investigating the development of physical aggressive behavior from infancy into toddlerhood. Using a longitudinal design, we aimed to identify distinct physical aggression trajectories from age 12 months up to 30 months. As cognitive functions have been proposed as mechanisms explaining social behavior (Beauchamp & Anderson, 2010; Dodge & Pettit, 2003), we examined whether the development of cognition from infancy (12 months) to toddlerhood (30 months) was related to the physical aggression trajectories. In this context, the cognitive functions inhibitory control, vocabulary and attention were investigated.

Chapter 3 describes a study examining whether prenatal risk predicted aggressive behavior at 12 and 20 months. Because maternal risk factors tend to co-occur or interact (Carneiro et al., 2016), we used a cumulative risk approach focusing on the number of risk factors during pregnancy. In addition, we examined the indirect effect of prenatal risk via inhibitory control at 12 months on aggression during infancy and toddlerhood. Because it has been shown that boys typically show lower levels of inhibitory control and higher levels of physical aggression during early childhood (Alink et al., 2006; Hay, 2017; Raaijmakers et al., 2008), the moderating role of gender was examined using a moderated-mediation model: it was investigated whether the

mediating role of inhibitory control in the risk-aggression relation was different for boys and girls.

Chapter 4 describes a study examining the relations between parental beliefs, parenting behavior, precursors of theory of mind and aggression during toddlerhood (at 20 months). Based on the existing literature, parental self-efficacy and perceived parental impact were selected to represent parental beliefs. Parenting behaviors, such as maternal sensitivity, maternal intrusiveness, and positive engagement were observed during mother-child interaction tasks. Children's imitation abilities and visual perspective-taking were examined as precursors of theory of mind. First, it was examined whether parental beliefs, parenting behavior and precursors of theory of mind predicted the level of aggressive behavior at 20 months (direct relations). Because little is known about the interrelations between these concepts during toddlerhood, the indirect effects of parental beliefs, via parenting behavior, and precursors of theory of mind on aggression at 20 months were examined.

It has been suggested that the impact of maternal environmental (prenatal) risk and child temperament on social functioning partly depends on children's cognitive development (Masten, 2001; Muris & Ollendick, 2005). Therefore, Chapter 5 involves a study investigating the moderating role of cognition (inhibitory control, attention and vocabulary at 30 months), in the relations between prenatal risk, temperamental negative affect (at 6 and 20 months) and aggressive behavior during toddlerhood (at 30 months).

In Chapter 6 the main findings of this dissertation are summarized and discussed.

References

Alink, L. R. A., Mesman, J., van Zeijl, J., Stolk, M. N., Juffer, F., Koot, H. M., . . . van IJzendoorn, M. H. (2006). The early childhood aggression curve: Development of physical aggression in 10-to 50-month-old children. *Child Development, 77*(4), 954-966. doi:10.1111/j.1467-8624.2006.00912.x

Ardelt, M., & Eccles, J. S. (2001). Effects of mothers' parental efficacy beliefs and promotive parenting strategies on inner-city youth. *Journal of Family Issues, 22*(8), 944-972. doi:10.1177/019251301022008001

Baillargeon, R., Scott, R. M., & He, Z. J. (2010). False-belief understanding in infants. *Trends in Cognitive Sciences, 14*(3), 110-118. doi:10.1016/j.tics.2009.12.006

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY, US: W. H. Freeman.

Barnes-Holmes, Y., McHugh, L., & Barnes-Holmes, D. (2004). Perspective-Taking and Theory of Mind: A Relational Frame Account. *The Behavior Analyst Today, 5*(1), 15-25. doi:10.1037/h0100133

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the Autistic-Child Have a Theory of Mind. *Cognition, 21*(1), 37-46. doi:10.1016/0010-0277(85)90022-8

Beauchamp, M. H., & Anderson, V. (2010). SOCIAL: An Integrative Framework for the Development of Social Skills. *Psychological Bulletin, 136*(1), 39-64. doi:10.1037/a0017768

Beaudoin, C., & Beauchamp, M. H. (2020). Social Cognition. In *Handbook of Clinical Neurology* (Vol. 173, pp. 255-264). Amsterdam: North-Holland Publishing.

Bellanti, C. J., & Bierman, K. L. (2000). Disentangling the impact of low cognitive ability and inattention on social behavior and peer relationships. *Journal of Clinical Child Psychology, 29*(1), 66-75. doi:10.1207/S15374424jccp2901_7

Belsky, J., Friedman, S. L., & Hsieh, K. H. (2001). Testing a core emotion-regulation prediction: Does early attentional persistence moderate the effect of infant negative emotionality on later development? *Child Development, 72*(1), 123-133. doi:10.1111/1467-8624.00269

Bennett, D. S., Marini, V. A., Berzenski, S. R., Carmody, D. P., & Lewis, M. (2013). Externalizing Problems in Late Childhood as a Function of Prenatal Cocaine Exposure and Environmental Risk. *Journal of Pediatric Psychology, 38*(3), 296-308. doi:10.1093/jpepsy/jss117

Boivin, M., Perusse, D., Dionne, G., Saysset, V., Zoccolillo, M., Tarabulsy, G. M., . . . Tremblay, R. E. (2005). The genetic-environmental etiology of parents' perceptions and self-assessed behaviours toward their 5-month-old infants in a large twin and singleton sample. *Journal of Child Psychology and Psychiatry, 46*(6), 612-630. doi:10.1111/j.1469-7610.2004.00375.x

Bongers, I. L., Koot, H. M., van der Ende, J., & Verhulst, F. C. (2004). Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Development, 75*(5), 1523-1537. doi:10.1111/j.1467-8624.2004.00755.x

Bradley, R. H., & Corwyn, R. F. (2008). Infant temperament, parenting, and externalizing behavior in first grade: a test of the differential susceptibility hypothesis. *Journal of Child Psychology and Psychiatry, 49*(2), 124-131. doi:10.1111/j-1469-7610.2007.01829.x

Brennan, L. M., Shaw, D. S., Dishion, T. J., & Wilson, M. (2012). Longitudinal Predictors of School-Age Academic Achievement: Unique Contributions of Toddler-Age Aggression, Oppositionality, Inattention, and Hyperactivity. *Journal of Abnormal Child Psychology, 40*(8), 1289-1300. doi:10.1007/s10802-012-9639-2

Broidy, L. M., Nagin, D. S., Tremblay, R. E., Bates, J. E., Brame, B., Dodge, K. A., . . . Vitaro, F. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: A six-site, cross-national study. *Developmental Psychology, 39*(2), 222-245. doi:10.1037/0012-1649.39.2.222

Brune, M., & Brune-Cohrs, U. (2006). Theory of mind - evolution, ontogeny, brain mechanisms and psychopathology. *Neuroscience and Biobehavioral Reviews, 30*(4), 437-455. doi:10.1016/j.neubiorev.2005.08.001

Buss, A. H. (1961). *The psychology of aggression*. New York: Wiley.

Buss, D. M., & Shackelford, T. K. (1997). Human aggression in evolutionary psychological perspective. *Clinical Psychology Review, 17*(6), 605-619. doi:10.1016/S0272-7358(97)00037-8

Calkins, S. D., Blandon, A. Y., Williford, A. P., & Keane, S. P. (2007). Biological, behavioral, and relational levels of resilience in the context of risk for early childhood behavior problems. *Development and Psychopathology, 19*(3), 675-700. doi:10.1017/S095457940700034x

Calkins, S. D., & Keane, S. P. (2009). Developmental origins of early antisocial behavior. *Development and Psychopathology, 21*(4), 1095-1109. doi:10.1017/S095457940999006x

Campbell, S. B., Shaw, D. S., & Gilliom, M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology, 12*(3), 467-488. doi:Doi 10.1017/S0954579400003114

Campbell, S. B., Spieker, S., Burchinal, M., & Poe, M. D. (2006). Trajectories of aggression from toddlerhood to age 9 predict academic and social functioning through age 12. *Journal of Child Psychology and Psychiatry, 47*(8), 791-800. doi:10.1111/j.1469-7610.2006.01636.x

Campbell, S. B., Spieker, S., Vandergrift, N., Belsky, J., Burchinal, M., & Network, N. E. C. C. R. (2010). Predictors and sequelae of trajectories of physical aggression in school-age boys and girls. *Development and Psychopathology, 22*(1), 133-150. doi:10.1017/S0954579409990319

Capage, L., & Watson, A. C. (2001). Individual Differences in Theory of Mind, Aggressive Behavior, and Social Skills In Young Children. *Early Education and Development, 12*(4), 613-628. doi:10.1207/s15566935eed1204_7

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28*(2), 595-616. doi:10.1207/s15326942dn2802_3

Carneiro, A., Dias, P., & Soares, I. (2016). Risk Factors for Internalizing and Externalizing Problems in the Preschool Years: Systematic Literature Review Based on the Child Behavior Checklist 1.5-5. *Journal of Child and Family Studies, 25*(10), 2941-2953. doi:10.1007/s10826-016-0456-z

Chang, H., Shelleby, E. C., Cheong, J., & Shaw, D. S. (2012). Cumulative Risk, Negative Emotionality, and Emotion Regulation as Predictors of Social Competence in Transition to School: A Mediated Moderation Model. *Social Development, 21*(4), 780-800. doi:10.1111/j.1467-9507.2011.00648.x

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2000). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development, 15*(4), 481-498. doi:Doi 10.1016/S0885-2014(01)00037-5

Chow, J. C., & Wehby, J. H. (2018). Associations Between Language and Problem Behavior: a Systematic Review and Correlational Meta-analysis. *Educational Psychology Review, 30*(1), 61-82. doi:10.1007/s10648-016-9385-z

Colombo, J. (2001). The development of visual attention in infancy. *Annual Review of Psychology, 52*, 337-367. doi:10.1146/annurev.psych.52.1.337

Colombo, J. (2002). Infant attention grows up: The emergence of a developmental cognitive neuroscience perspective. *Current Directions in Psychological Science, 11*(6), 196-200. doi:10.1111/1467-8721.00199

Côté, S. M., Boivin, M., Nagin, D. S., Japel, C., Xu, Q. A., Zoccolillo, M., . . . Tremblay, R. E. (2007). The role of maternal education and nonmaternal care services in the prevention of children's physical aggression problems. *Archives of General Psychiatry, 64*(11), 1305-1312. doi:10.1001/archpsyc.64.11.1305

Côté, S. M., Vaillancourt, T., LeBlanc, J. C., Nagin, D. S., & Tremblay, R. E. (2006). The development of physical aggression from toddlerhood to pre-adolescence: A nation wide longitudinal study of Canadian children. *Journal of Abnormal Child Psychology, 34*(1), 71-85. doi:10.1007/s10802-005-9001-z

Dale, P., & Goodman, J. (2005). Commonality and individual differences in vocabulary growth. In M. Tomasello & D. Slobin (Eds.), *Beyond nature-nurture: Essays in honour of Elizabeth Bates* (pp. 41-78). Mahwah, NJ: Lawrence Erlbaum Associates.

de Bruijn, A. T. C. E., van Bakel, H. J. A., & van Baar, A. L. (2009). Sex differences in the relation between prenatal maternal emotional complaints and child outcome. *Early Human Development, 85*(5), 319-324. doi:10.1016/j.earlhumdev.2008.12.009

De Pauw, S. S. W., & Mervielde, I. (2010). Temperament, Personality and Developmental Psychopathology: A Review Based on the Conceptual

Dimensions Underlying Childhood Traits. *Child Psychiatry and Human Development, 41*(3), 313-329. doi:10.1007/s10578-009-0171-8

DeLisi, M., & Vaughn, M. G. (2014). Foundation for a temperament-based theory of antisocial behavior and criminal justice system involvement. *Journal of Criminal Justice, 42*(1), 10-25. doi:10.1016/j.jcrimjus.2013.11.001

Delle Luche, C., Floccia, C., Granjon, L., & Nazzi, T. (2017). Infants' First Words are not Phonetically Specified: Own Name Recognition in British English-Learning 5-Month-Olds. *Infancy, 22*(3), 362-388. doi:10.1111/infa.12151

Dionne, G., Tremblay, R., Boivin, M., Laplante, D., & Perusse, D. (2003). Physical aggression and expressive vocabulary in 19-month-old twins. *Developmental Psychology, 39*(2), 261-273. doi:10.1037/0012-1649.39.2.261

Dodge, K. A., & Pettit, G. S. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology, 39*(2), 349-371. doi:10.1037/0012-1649.39.2.349

Ellis, M. L., Weiss, B., & Lochman, J. E. (2009). Executive Functions in Children: Associations with Aggressive Behavior and Appraisal Processing. *Journal of Abnormal Child Psychology, 37*(7), 945-956. doi:10.1007/s10802-009-9321-5

Estrem, T. L. (2005). Relational and Physical Aggression among Preschoolers: The Effect of Language Skills and Gender. *Early Education & Development, 16*(2), 207-232. doi:10.1207/s15566935eed1602_6

Evans, G. W., Li, D. P., & Whipple, S. S. (2013). Cumulative Risk and Child Development. *Psychological Bulletin, 139*(6), 1342-1396. doi:10.1037/a0031808

Fatima, S., & Sharif, I. (2017). Executive functions, parental punishment, and aggression: Direct and moderated relations. *Social Neuroscience, 12*(6), 717-729. doi:10.1080/17470919.2016.1240710

Flavell, J. H., Everett, B. A., Croft, K., & Flavell, E. R. (1981). Young Childrens Knowledge About Visual-Perception: Further Evidence for the Level 1-Level 2 Distinction. *Developmental Psychology, 17*(1), 99-103. doi:10.1037/0012-1649.17.1.99

Fossum, S., Handegard, B. H., Adolfsen, F., Vis, S. A., & Wynn, R. (2016). A Meta-Analysis of Long-Term Outpatient Treatment Effects for Children and Adolescents with Conduct Problems. *Journal of Child and Family Studies, 25*(1), 15-29. doi:10.1007/s10826-015-0221-8

Fox, N. A., & Rutter, M. (2010). Introduction to the Special Section on The Effects of Early Experience on Development. *Child Development, 81*(1), 23-27. doi:DOI 10.1111/j.1467-8624.2009.01379.x

Frick, P. J. (2004). Integrating research on temperament and childhood psychopathology: Its pitfalls and promise. *Journal of Clinical Child and Adolescent Psychology, 33*(1), 2-7. doi:Doi 10.1207/S15374424jccp3301_1

Fusaro, M., Harris, P. L., & Pan, B. A. (2012). Head nodding and head shaking gestures in children's early communication. *First Language, 32*(4), 439-458. doi:10.1177/0142723711419326

Gallup, G. G. (1998). Self-awareness and the evolution of social intelligence. *Behavioural Processes, 42*(2-3), 239-247. doi:Doi 10.1016/S0376-6357(97)00079-X

Ganzel, B. L., Morris, P. A., & Wethington, E. (2010). Allostasis and the Human Brain: Integrating Models of Stress From the Social and Life Sciences. *Psychological Review, 117*(1), 134-174. doi:10.1037/a0017773

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: a review using an integrative framework. *Psychological Bulletin, 134*(1), 31-60. doi:10.1037/0033-2909.134.1.31

Garratt, E. A., Chandola, T., Purdam, K., & Wood, A. M. (2017). Income and Social Rank Influence UK Children's Behavioral Problems: A Longitudinal Analysis. *Child Development, 88*(4), 1302-1320. doi:10.1111/cdev.12649

Gartstein, M. A., Putnam, S. P., & Rothbart, M. K. (2012). Etiology of Preschool Behavior Problems: Contributions of Temperament Attributes in Early Childhood. *Infant Mental Health Journal, 33*(2), 197-211. doi:10.1002/imhj.21312

Gassman-Pines, A., & Yoshikawa, H. (2006). The effects of antipoverty programs on children's cumulative level of poverty-related risk. *Developmental Psychology, 42*(6), 981-999. doi:10.1037/0012-1649.42.6.981

Gendreau, P. L., & Archer, J. (2005). Subtypes of Aggression in Humans and Animals. In R. E. Tremblay, W. W. Hartup, & J. Archer (Eds.), *Developmental Origins of Aggression* (pp. 25-46). New York: The Guilford Press.

Gielen, W. J. M., & Akkermans, M. M. P. (2019). Criminaliteit en slachtofferschap. In R. Choenni, S. W. van den Braak, & P. F. M. Platenburg (Eds.), *Criminaliteit en rechtshandhaving 2018*.

Girard, L. C., Pingault, J. B., Falissard, B., Boivin, M., Dionne, G., & Tremblay, R. E. (2014). Physical Aggression and Language Ability from 17 to 72 Months: Cross-Lagged Effects in a Population Sample. *PloS One, 9*(11), e112185. doi:10.1371/journal.pone.0112185

Gogate, L. J., & Hollich, G. (2010). Invariance Detection Within an Interactive System: A Perceptual Gateway to Language Development. *Psychological Review, 117*(2), 496-516. doi:10.1037/a0019049

Gopnik, A., Slaughter, V., & Meltzoff, A. (1994). Changing your views: How understanding visual perception can lead to a new theory of the mind. In C. Lewis & P. Mitchell (Eds.), *Children's early understanding of mind: Origins and development* (pp. 157-181). Hillsdale, NJ: Lawrense Erlbaum Associates, Inc.

Hay, D. F. (2017). The Early Development of Human Aggression. *Child Development Perspectives, 11*(2), 102-106. doi:10.1111/cdep.12220

Hay, D. F., Nash, A., Caplan, M., Swartzentruber, J., Ishikawa, F., & Vespo, J. E. (2011). The emergence of gender differences in physical aggression in the context of conflict between young peers. *British Journal of Developmental Psychology, 29*(2), 158-175. doi:10.1111/j.2044-835X.2011.02028.x

Hay, D. F., Perra, O., Hudson, K., Waters, C. S., Mundy, L., Phillips, R., . . . CCDS Team. (2010). Identifying early signs of aggression: Psychometric properties of the Cardiff Infant Contentiousness Scale. *Aggressive Behavior, 36*(6), 351-357. doi:10.1002/ab.20363

Hill, A. L., Degnan, K. A., Calkins, S. D., & Keane, S. P. (2006). Profiles of externalizing behavior problems for boys and girls across preschool: The roles of emotion regulation and inattention. *Developmental Psychology, 42*(5), 913-928. doi:10.1037/0012-1649.42.5.913

Hoeffler, A. (2017). What are the costs of violence? *Politics Philosophy & Economics, 16*(4), 422-445. doi:10.1177/1470594x17714270

Holochwost, S. J., Gariepy, J. L., Propper, C. B., Gardner-Neblett, N., Volpe, V., Neblett, E., & Mills-Koonce, W. R. (2016). Sociodemographic risk, parenting, and executive functions in early childhood: The role of ethnicity. *Early Childhood Research Quarterly, 36*, 537-549. doi:10.1016/j.ecresq.2016.02.001

Hughes, C., & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: a family affair? *Developmental Neuropsychology, 28*(2), 645-668. doi:10.1207/s15326942dn2802_5

Hughes, C., & Ensor, R. (2009). Independence and interplay between maternal and child risk factors for preschool problem behaviors? *International Journal of Behavioral Development, 33*(4), 312-322. doi:10.1177/0165025408101274

Hughes, C., & Leekam, S. (2004). What are the links between theory of mind and social relations? Review, reflections and new directions for studies of typical and atypical development. *Social Development, 13*(4), 590-619. doi:10.1111/j.1467-9507.2004.00285.x

Huijbregts, S. C. J., Séguin, J. R., Zoccolillo, M., Boivin, M., & Tremblay, R. E. (2008). Maternal prenatal smoking, parental antisocial behavior, and early childhood physical aggression. *Development and Psychopathology, 20*(2), 437-453. doi:10.1017/S0954579408000217

Huizink, A. C., & de Rooij, S. R. (2018). Prenatal stress and models explaining risk for psychopathology revisited: Generic vulnerability and divergent pathways. *Development and Psychopathology, 30*(3), 1041-1062. doi:10.1017/S0954579418000354

Jackson, D. B. (2017). The interplay between early language and temperamental difficulties in the prediction of severe antisocial behavior among males. *Journal of Criminal Psychology, 7*(2), 70-80. doi:10.1108/Jcp-11-2016-0037

Jones, T. L., & Prinz, R. J. (2005). Potential roles of parental self-efficacy in parent and child adjustment: A review. *Clinical Psychology Review, 25*(3), 341-363. doi:10.1016/j.cpr.2004.12.004

Juster, R. P., Bizik, G., Picard, M., Arsenault-Lapierre, G., Sindi, S., Trepanier, L., . . . Lupien, S. J. (2011). A transdisciplinary perspective of chronic stress in relation to psychopathology throughout life span development. *Development and Psychopathology, 23*(3), 725-776. doi:10.1017/S0954579411000289

Karreman, A., de Haas, S., van Tuijl, C., van Aken, M. A. G., & Dekovic, M. (2010). Relations among temperament, parenting and problem behavior in young children. *Infant Behavior & Development, 33*(1), 39-49. doi:10.1016/j.infbeh.2009.10.008

Keenan, K., & Shaw, D. (1997). Developmental and social influences on young girls' early problem behavior. *Psychological Bulletin, 121*(1), 95-113. doi:10.1037//0033-2909.121.1.95

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology, 36*(2), 220-232. doi:10.1037/0012-1649.36.2.220

Kochanska, G., Tjebkes, T. L., & Forman, D. R. (1998). Children's emerging regulation of conduct: restraint, compliance, and internalization from infancy to the second year. *Child Development, 69*(5), 1378-1389. doi:10.2307/1132272

LaGasse, L. L., Derauf, C., Smith, L. M., Newman, E., Shah, R., Neal, C., . . . Lester, B. M. (2012). Prenatal Methamphetamine Exposure and Childhood Behavior Problems at 3 and 5 Years of Age. *Pediatrics, 129*(4), 681-688. doi:10.1542/peds.2011-2209

LaPrairie, J. L., Schechter, J. C., Robinson, B. A., & Brennan, P. A. (2011). Perinatal Risk Factors in the Development of Aggression and Violence. *Advances in Genetics, 75,* 215-253. doi:10.1016/B978-0-12-380858-5.00004-6

Laranjo, J., Bernier, A., Meins, E., & Carlson, S. M. (2014). The roles of maternal mind-mindedness and infant security of attachment in predicting preschoolers' understanding of visual perspective taking and false belief. *Journal of Experimental Child Psychology, 125,* 48-62. doi:10.1016/j.jecp.2014.02.005

Latimer, K., Wilson, P., Kemp, J., Thompson, L., Sim, F., Gillberg, C., . . . Minnis, H. (2012). Disruptive behaviour disorders: a systematic review of environmental antenatal and early years risk factors. *Child Care Health and Development, 38*(5), 611-628. doi:10.1111/j.1365-2214.2012.01366.x

Lawson, K. R., & Ruff, H. A. (2004). Early attention and negative emotionality predict later cognitive and behavioural function. *International Journal of Behavioral Development, 28*(2), 157-165. doi:10.1080/01650250344000361

Lee, C. C., Jhang, Y., Chen, L. M., Relyea, G., & Oller, D. K. (2017). Subtlety of Ambient-Language Effects in Babbling: A Study of English- and Chinese-Learning Infants at 8, 10, and 12 Months. *Language Learning and Development, 13*(1), 100-126. doi:10.1080/15475441.2016.1180983

Lengua, L. J. (2002). The contribution of emotionality and self-regulation to the understanding of children's response to multiple risk. *Child Development, 73*(1), 144-161. doi:10.1111/1467-8624.00397

Liszkowski, U., Carpenter, M., Striano, T., & Tomasello, M. (2006). 12-and 18-month-olds point to provide information for others. *Journal of Cognition and Development, 7*(2), 173-187. doi:10.1207/s15327647jcd0702_2

Masten, A. S. (2001). Ordinary magic - Resilience processes in development. *American Psychologist, 56*(3), 227-238. doi:10.1037//0003-066x.56.3.227

Mazza, J. R., Pingault, J. B., Booij, L., Boivin, M., Tremblay, R., Lambert, J., . . . Cote, S. (2017). Poverty and behavior problems during early childhood: The mediating role of maternal depression symptoms and parenting. *International Journal of Behavioral Development, 41*(6), 670-680. doi:10.1177/0165025416657615

McCartney, K., Burchinal, M., Clarke-Stewart, A., Bub, K. L., Owen, M. T., Belsky, J., & Network, N. E. C. C. R. (2010). Testing a Series of Causal Propositions Relating Time in Child Care to Children's Externalizing Behavior (vol 46, pg 1, 2010). *Developmental Psychology, 46*(2), 445-445. doi:10.1037/a0018906

McCollister, K. E., French, M. T., & Fang, H. (2010). The cost of crime to society: New crime-specific estimates for policy and program evaluation. *Drug and Alcohol Dependence, 108*(1-2), 98-109. doi:10.1016/j.drugalcdep.2009.12.002

McCrae, R. R., Costa, P. T., Ostendorf, F., Angleitner, A., Hrebickova, M., Avia, M. D., . . . Smith, P. B. (2000). Nature over nurture: Temperament, personality, and life span development. *Journal of Personality and Social Psychology, 78*(1), 173-186. doi:10.1037/0022-3514.78.1.173

McEwen, B. S. (2000). Allostasis and allostatic load: Implications for neuropsychopharmacology. *Neuropsychopharmacology, 22*(2), 108-124. doi:10.1016/S0893-133x(99)00129-3

McKee, L., Colletti, C., Rakow, A., Jones, D. J., & Forehand, R. (2008). Parenting and child externalizing behaviors: Are the associations specific or diffuse? *Aggression and Violent Behavior, 13*(3), 201-215. doi:10.1016/j.avb.2008.03.005

Meltzoff, A. N. (2005). Imitation and Other Minds: The "Like Me" Hypothesis. In S. Hurley & N. Chater (Eds.), *Perspectives on Imitation: From Neuroscience to Social Science* (Vol. 2, pp. 55-77). Cambridge, MA: MIT Press.

Meltzoff, A. N., & Moore, M. K. (1983). Newborn-Infants Imitate Adult Facial Gestures. *Child Development, 54*(3), 702-709. doi:10.2307/1130058

Menting, B., van Lier, P. A., & Koot, H. M. (2011). Language skills, peer rejection, and the development of externalizing behavior from kindergarten to fourth grade. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 52*(1), 72-79. doi:10.1111/j.1469-7610.2010.02279.x

Mesman, J., Bongers, I. L., & Koot, H. M. (2001). Preschool developmental pathways to preadolescent internalizing and externalizing problems. *Journal of Child*

Psychology and Psychiatry and Allied Disciplines, 42(5), 679-689. doi:10.1017/S0021963001007351

Meunier, J. C., Roskam, I., Stievenart, M., van de Moortele, G., Browne, D. T., & Kumar, A. (2011). Externalizing behavior trajectories: The role of parenting, sibling relationships and child personality. *Journal of Applied Developmental Psychology, 32*(1), 20-33. doi:10.1016/j.appdev.2010.09.006

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49-100. doi:10.1006/cogp.1999.0734

Monroe, S. M., & Simons, A. D. (1991). Diathesis-stress theories in the context of life stress research: implications for the depressive disorders. *Psychological Bulletin, 110*(3), 406-425.

Moolenaar, D. E. G., Vlemmings, M., van Tulder, F. P., & de Winter, J. (2019). Kosten van criminaliteit. In R. Choenni, S. W. van den Braak, & P. F. M. Platenburg (Eds.), *Criminaliteit en rechtshandhaving 2018* (pp. 88-94).

Moran, L. R., Lengua, L. J., & Zalewski, M. (2013). The Interaction between Negative Emotionality and Effortful Control in Early Social-emotional Development. *Social Development, 22*(2), 340-362. doi:10.1111/sode.12025

Muris, P., & Ollendick, T. H. (2005). The role of temperament in the etiology of child psychopathology. *Clinical Child and Family Psychology Review, 8*(4), 271-289. doi:10.1007/s10567-005-8809-y

Murphy, L. M. B., Laurie-Rose, C., Brinkman, T. M., & McNamara, K. A. (2007). Sustained attention and social competence in typically developing preschool-aged children. *Early Child Development and Care, 177*(2), 133-149. doi:10.1080/03004430500349559

Nærde, A., Ogden, T., Janson, H., & Zachrisson, H. D. (2014). Normative Development of Physical Aggression From 8 to 26 Months. *Developmental Psychology, 50*(6), 1710-1720. doi:10.1037/a0036324

Nigg, J. T. (2006). Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 47*(3-4), 395-422. doi:10.1111/j.1469-7610.2006.01612.x

Northerner, L. M., Trentacosta, C. J., & McLear, C. M. (2016). Negative Affectivity Moderates Associations Between Cumulative Risk and At-Risk Toddlers' Behavior Problems. *Journal of Child and Family Studies, 25*(2), 691-699. doi:10.1007/s10826-015-0248-x

Olson, S. L., Choe, D. E., & Sameroff, A. J. (2017). Trajectories of child externalizing problems between ages 3 and 10 years: Contributions of children's early effortful control, theory of mind, and parenting experiences. *Development and Psychopathology, 29*(4), 1333-1351. doi:10.1017/S095457941700030x

Olson, S. L., Lopez-Duran, N., Lunkenheimer, E. S., Chang, H., & Sameroff, A. J. (2011). Individual differences in the development of early peer aggression:

Integrating contributions of self-regulation, theory of mind, and parenting. *Development and Psychopathology, 23*(1), 253-266. doi:10.1017/S0954579410000775

Olson, S. L., Sameroff, A., Kerr, D. C. R., Lopez, N. L., & Wellman, H. M. (2005). Developmental foundations of externalizing problems in young children: The role of effortful control. *Development and Psychopathology, 17*(1), 25-45. doi:10.1017/S0954579405050029

Patterson, G. R. (1986). Performance Models for Antisocial Boys. *American Psychologist, 41*(4), 432-444. doi:10.1037/0003-066x.41.4.432

Patterson, G. R. (2002). The early development of coercive family process. In J. B. Reid, G. R. Patterson, & J. Snyder (Eds.), *Antisocial behavior in children and adolescents: a developmental analysis and model for intervention* (pp. 25-44). Washington, DC, US: American Psychological Association.

Pavarini, G., Souza, D. D., & Hawk, C. K. (2013). Parental Practices and Theory of Mind Development. *Journal of Child and Family Studies, 22*(6), 844-853. doi:10.1007/s10826-012-9643-8

Petersen, I. T., Bates, J. E., D'Onofrio, B. M., Coyne, C. A., Lansford, J. E., Dodge, K. A., . . . Van Hulle, C. A. (2013). Language Ability Predicts the Development of Behavior Problems in Children. *Journal of Abnormal Psychology, 122*(2), 542-557. doi:10.1037/a0031963

Pinquart, M. (2017). Associations of Parenting Dimensions and Styles With Externalizing Problems of Children and Adolescents: An Updated Meta-Analysis. *Developmental Psychology, 53*(5), 873-932. doi:10.1037/dev0000295

Premack, D., & Woodruff, G. (1978). Does the Chimpanzee Have a Theory of Mind. *Behavioral and Brain Sciences, 1*(4), 515-526. doi:10.1017/S0140525x00076512

Raaijmakers, M. A. J., Smidts, D. P., Sergeant, J. A., Maassen, G. H., Posthumus, J. A., van Engeland, H., & Matthys, W. (2008). Executive functions in preschool children with aggressive behavior: Impairments in inhibitory control. *Journal of Abnormal Child Psychology, 36*(7), 1097-1107. doi:10.1007/s10802-008-9235-7

Rogers, S. J., & Pennington, B. F. (1991). A theoretical approach to the deficits in infantile autism. *Development and Psychopathology, 3*, 137-162. doi:10.1017/S0954579400000043

Roman, G. D., Ensor, R., & Hughes, C. (2016). Does executive function mediate the path from mothers' depressive symptoms to young children's problem behaviors? *Journal of Experimental Child Psychology, 142*, 158-170. doi:10.1016/j.jecp.2015.09.022

Rose, S. A., Feldman, J. F., & Jankowski, J. J. (2009). A Cognitive Approach to the Development of Early Language. *Child Development, 80*(1), 134-150. doi:10.1111/j.1467-8624.2008.01250.x

Roth-Hanania, R., Davidoy, M., & Zahn-Waxler, C. (2011). Empathy development from 8 to 16 months: Early signs of concern for others. *Infant Behavior & Development, 34*(3), 447-458. doi:10.1016/j.infbeh.2011.04.007

Rothbart, M. K. (2007). Temperament, development, and personality. *Current Directions in Psychological Science, 16*(4), 207-212. doi:10.1111/j.1467-8721.2007.00505.x

Rothbart, M. K., Ahadi, S. A., & Evans, D. E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology, 78*(1), 122-135. doi:Doi 10.1037/0022-3514.78.1.122

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In N. Eisenberg, W. Damon, & R. M. Lerner (Eds.), *Handbook of Child Psychology: Social, Emotional, and Personality Development* (6 ed., Vol. 3, pp. 99-166). Hoboken, NJ: John Wiley & Sons.

Rothbart, M. K., & Posner, M. (2001). Mechanism and variation in the development of attentional networks. In C. Nelson & M. Luciana (Eds.), *Handbook of developmental cognitive neuroscience* (pp. 353-363). Cambridge, MA: MIT Press.

Ruff, H. A., & Capozzoli, M. C. (2003). Development of attention and distractibility in the first 4 years of life. *Developmental Psychology, 39*(5), 877-890. doi:10.1037/0012-1649.39.5.877

Sanson, A., Hemphill, S. A., & Smart, D. (2004). Connections between temperament and social development: A review. *Social Development, 13*(1), 142-170. doi:10.1046/j.1467-9507.2004.00261.x

Sanson, A., & Rothbart, M. K. (1995). Child temperament and parenting. In M. H. Bornstein (Ed.), *Handbook of parenting* (Vol. 4, pp. 299-231). Mahwah, NJ: Lawrence Erlbaum Associates.

Schoemaker, K., Mulder, H., Dekovic, M., & Matthys, W. (2013). Executive Functions in Preschool Children with Externalizing Behavior Problems: A Meta-Analysis. *Journal of Abnormal Child Psychology, 41*(3), 457-471. doi:10.1007/s10802-012-9684-x

Sigel, I. E., & Mc Gillicuddy-De Lisi, A. V. (2002). Parent beliefs are cognitions: The dynamic belief systems model. In M. H. Bornstein (Ed.), *Handbook of parenting: Being and becoming a parent* (pp. 485-508). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Sterling, P. (2012). Allostasis: A model of predictive regulation. *Physiology & Behavior, 106*(1), 5-15. doi:10.1016/j.physbeh.2011.06.004

Suurland, J., van der Heijden, K. B., Huijbregts, S. C. J., Smaling, H. J. A., de Sonneville, L. M. J., van Goozen, S. H. M., & Swaab, H. (2016). Parental Perceptions of Aggressive Behavior in Preschoolers: Inhibitory Control Moderates the Association With Negative Emotionality. *Child Development, 87*(1), 256-269. doi:10.1111/cdev.12455

Szagun, G., Steinbrink, C., Franik, M., & Stumper, B. (2006). Development of vocabulary and grammar in young German-speaking children assessed with a German language development inventory. *First Language, 26*(3), 259-280.

Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A new look at infant pointing. *Child Development, 78*(3), 705-722. doi:10.1111/j.1467-8624.2007.01025.x

Torola, H., Lehtihalmes, M., Heikkinen, H., Olsen, P., & Yliherva, A. (2012). Early vocalization of preterm infants with extremely low birth weight (ELBW), part II: from canonical babbling up to the appearance of the first word. *Clinical Linguistics & Phonetics, 26*(4), 345-356. doi:10.3109/02699206.2011.636500

Towe-Goodman, N. R., Stifter, C. A., Coccia, M. A., Cox, M. J., & Investigat, F. L. P. K. (2011). Interparental aggression, attention skills, and early childhood behavior problems. *Development and Psychopathology, 23*(2), 563-576. doi:10.1017/S0954579411000216

Tremblay, R. E., Japel, C., Pérusse, D., McDuff, P., Boivin, M., & Zoccolillo, M. (1999). The search for the age of "onset" of physical aggression: Rousseau and Bandura revisited. *Criminal Behavior and Mental Health, 9*, 8-23. doi:10.1002/cbm.288

Tremblay, R. E., Nagin, D. S., Séguin, J. R., Zoccolillo, M., Zelazo, P. D., Boivin, M., . . . Japel, C. (2004). Physical aggression during early childhood: trajectories and predictors. *Pediatrics, 114*(1), e43-50. doi:10.1542/peds.114.1.e43

Trentacosta, C. J., Hyde, L. W., Shaw, D. S., Dishion, T. J., Gardner, F., & Wilson, M. (2008). The relations among cumulative risk, parenting, and behavior problems during early childhood. *Journal of Child Psychology and Psychiatry, 49*(11), 1211-1219. doi:10.1111/j.1469-7610.2008.01941.x

van Aken, C., Junger, M., Verhoeven, M., van Aken, M. A. G., & Dekovic, M. (2007). The interactive effects of temperament and maternal parenting on toddlers externalizing behaviours. *Infant and Child Development, 16*(5), 553-572. doi:10.1002/icd.529

van Goozen, S. H. M., Fairchild, G., Snoek, H., & Harold, G. T. (2007). The evidence for a neurobiological model of childhood antisocial behavior. *Psychological Bulletin, 133*(1), 149-182. doi:10.1037/0033-2909.133.1.149

Van Zeijl, J., Mesman, J., Stolk, M. N., Alink, L. R. A., Van IJzendoorn, M. H., Bakermans-Kranenburg, M. J., . . . Koot, H. M. (2007). Differential susceptibility to discipline: The moderating effect of child temperament on the association between maternal discipline and early childhood externalizing problems. *Journal of Family Psychology, 21*(4), 626-636. doi:10.1037/0893-3200.21.4.626

Velders, F. P., Dieleman, G., Henrichs, J., Jaddoe, V. W., Hofman, A., Verhulst, F. C., . . . Tiemeier, H. (2011). Prenatal and postnatal psychological symptoms of parents and family functioning: the impact on child emotional and behavioural problems. *European Child and Adolescent Psychiatry, 20*(7), 341-350. doi:10.1007/s00787-011-0178-0

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72*(3), 655-684. doi:10.1111/1467-8624.00304

Wildeboer, A., Thijssen, S., van IJzendoorn, M. H., van der Ende, J., Jaddoe, V. W. V., Verhulst, F. C., . . . Bakermans-Kranenburg, M. J. (2015). Early childhood aggression trajectories: Associations with teacher-reported problem behaviour. *International Journal of Behavioral Development, 39*(3), 221-234. doi:10.1177/0165025414562239

Zimmer-Gembeck, M. J., & Thomas, R. (2010). Parents, parenting and toddler adaptation Evidence from a national longitudinal study of Australian children. *Infant Behavior & Development, 33*(4), 518-529. doi:10.1016/j.infbeh.2010.07.004