Aggressive Behavior in Preschool Children
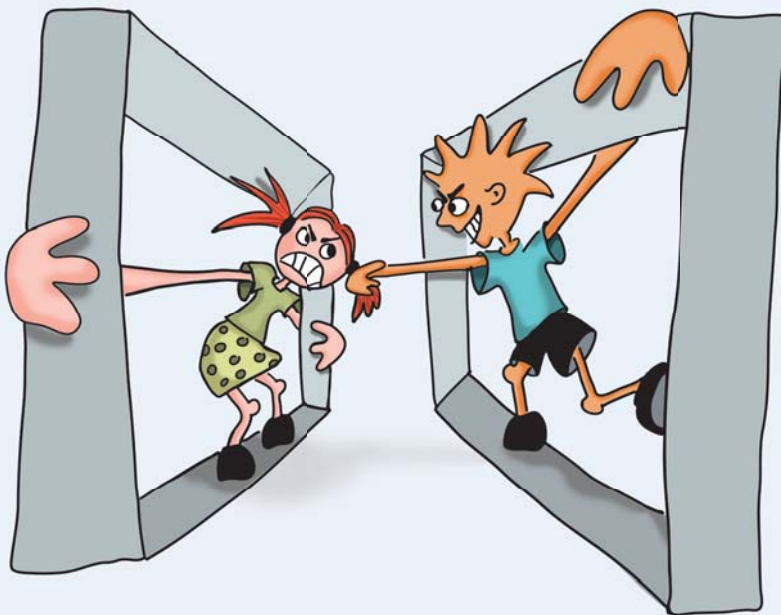
Neuropsychological correlates, Costs of service use and Preventive efforts

Maartje Raaijmakers

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Agressief gedrag bij kleuters

Neuropsychologische aspecten, kosten van hulpverlening en preventieve inspanningen

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de Universiteit Utrecht
op gezag van de rector magnificus, prof. dr. J.C. Stoof,
ingevolge het besluit van het college voor promoties
in het openbaar te verdedigen
op donderdag 30 oktober 2008 des ochtends te 10.30 uur

door

Maartje Anna Josephina Raaijmakers
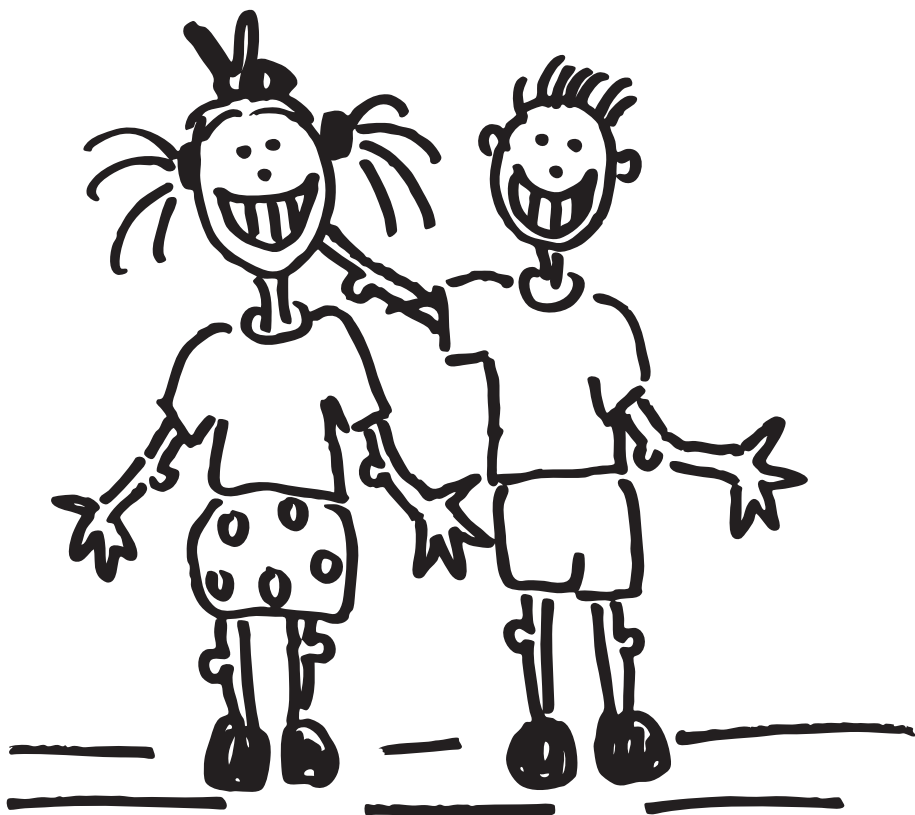
geboren op 30 oktober 1981, te Heerhugowaard

Promotoren: Prof. dr. W. Matthys
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Chapter 1

General Introduction

Aggressive Behavior

Aggressive behavior is part of the typical development of young children (Tremblay, 2000). At the age of 2 or 3 the vast majority of children shows a peak in their level of aggression (Alink et al., 2006). As a consequence of the lack of verbal abilities on the one hand and their increased motor skills and sense of autonomy on the other, young children use physical aggression as a tool to express themselves (Campbell, 2002). During the preschool period a decline in the level of physical aggression appears. Although this is the case in most children, some children continue to show a high level of aggression and are at risk for the development of a chronic and persistent pattern of aggressive behavior (Broidy et al., 2003; Shaw, Lacourse & Nagin, 2005).

Several studies investigated trajectories of aggressive behavior over time and found that a high level of aggressive behavior in childhood is a strong predictor of delinquency and antisocial behavior later in life (Nagin & Tremblay, 1999). In a longitudinal study, Nagin and Tremblay (1999) followed a group of boys from 6 to 15 years of age and identified four distinct trajectories of aggression: a group of children with a persistent high level of physical aggression, a group of children who started of showing a high level of aggression but it then declines to a moderate level, a group of children with a moderate level of physical aggression which declines to a low level, and a trajectory in which physically aggressive behavior was almost absent. The study of Broidy et al (2003) used data from six different sites on the development of aggressive behavior. In every set of data, two to four trajectories of aggression could be identified in groups of children aged 4 to 13 years. At least two trajectories were found to be similar at all sites; a stable trajectory of low levels of aggression and a stable trajectory of high levels of aggression. The trajectory with persistent high levels of physical aggression was found in approximately 10% of the children, mainly boys, and it was indicated that children following this trajectory are at the highest risk for later violent behavior or delinquency. Comparable results were found by Schaeffer et al (2006) who followed children over the period from 6 to 20 years of age; a low aggression-disruption trajectory and a chronic high aggression-disruption trajectory were identified for both boys and girls, although girls had lower rates of antisocial outcomes than boys.

Although several studies into the development of aggression identified different numbers of trajectories or found different trajectories for boys and girls (Broidy et al., 2003; Côté, Vaillancourt, LeBlanc, Nagin & Tremblay, 2006; Schaeffer et al., 2006; Shaw et al., 2005), all studies report on the existence of a chronic trajectory, i.e., a group of children whose level of aggression is persistently high from an early age onwards. Even in infants and toddlers this persistent trajectory of aggression could be identified (Tremblay et al., 2004; Alink et al., 2006). This stresses the importance of the preschool period as a time to intervene, for the persistent pathway from early-onset aggressive behavior into adolescent or adult delinquency or criminality may best be interrupted early in life when behavioral patterns are more easily modified (Tremblay, 2006).

Disruptive Behavior Disorders

Children who show a chronic and persistent pattern of aggressive behavior are at risk for the development of Disruptive Behavior Disorders (DBD; Moffitt, Caspi, Harrington & Milne, 2002), a term covering both Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). ODD is characterized by a persistent pattern of negativistic, disobedient,

hostile and defiant behavior toward authority figures, which is inappropriate for the age and developmental level of the child. Children with ODD are for example easily irritated, often angry, and blame other people for their own mistakes (APA, 2000). CD is characterized by a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated. Children with a diagnosis of CD are, e.g., cruel to animals, often involved in fights, and lie to other people. ODD is often regarded as a precursor or mild form of CD (APA, 2000). For both these disorders, comorbidity with Attention Deficit Hyperactivity Disorder (ADHD) is high (Angold, Costello & Erlkani, 1999). See Appendices A and B for an overview of the diagnostic criteria of ODD and CD according to the DSM-IV (APA, 2000).

Prevalence
DBD are among the most commonly diagnosed child psychiatric disorders and constitute one of the main reasons for referral to mental health services (Loeber, Burke, Lahey, Winters & Zera, 2000; Kazdin & Weisz, 2003). Prevalence rates differ between countries, ages, and gender, and depend on the criteria that are used. Lahey, Miller, Gordon and Riley (1999) reported a prevalence of DBD of 5.2% (ODD = 3.2% and CD = 2.0%) in children aged 4 to 18 according to the DSM-IV criteria (APA, 1994). A UK survey using ICD-10 criteria for CD found a prevalence of 5% in 5-15-year-olds (Meltzer, Gatward, Goodman, & Ford, 2000). Another British study into the prevalence of DBD according to the DSM-IV criteria (APA, 1994) revealed prevalence rates of 2.4% for girls and 6.0% for boys aged 5 to 10 years (Messer, Goodman, Rowe, Meltzer & Maughan, 2006). A Danish study into the population prevalence of child psychiatric disorders estimated the prevalence of DBD at 5.0% in 8- to 9-year-old children (Petersen, Bilenberg, Hoerder & Gillberg, 2006).

Unfortunately, prevalence rates of DBD in young children in the general population of the Netherlands are scarce. A study into the prevalence of child psychiatric diagnoses in children aged 6 to 8 from the province of Limburg revealed a mean prevalence rate of 12.8% for DBD (9.3% for girls and 15.2% for boys) based on a structured diagnostic interview (Kroes et al., 2001). In older children, aged 13 to 18 years, ODD was prevalent in 0.7% of the Dutch population and CD in 5.6% (Verhulst, Van der Ende, Ferdinand & Kasius, 1997).

In their extensive review, Lahey et al (1999) reported that CD occurred more often in boys than in girls and that evidence on gender differences in ODD remains inconsistent. Similarly, Rutter, Giller and Hagell (1998) found no gender differences in prevalence rates of ODD in young children, whereas CD appeared to be significantly more common in boys than in girls. However, more recent studies found that ODD occurred at least twice as often in boys than in girls (Maughan, Rowe, Messer, Goodman & Meltzer, 2004; Messer et al., 2006). In addition, DBD are more prevalent in urbanized areas and in families with low socio-economic status (low family income and poor parental education and occupational status; Lahey et al., 1999).

Early onset and developmental consequences of DBD
Children who exhibit a high level of aggressive behavior from an early age onwards are more likely to engage in life-course-persistent antisocial behavior (Moffitt et al., 2002). The prognosis for the 'early starters' is poor, and the presence of factors such as comorbidity with ADHD, or a high rate of physical aggression are associated with even worse developmental

outcomes (Maughan & Rutter, 2001). 'Late starters' or children whose aggressive behavior has its onset in adolescence are more likely to show conduct problems that are transient than 'early starters' (Moffitt et al., 2002). High levels of antisocial behavior or criminality in adulthood are rarely shown by individuals with the adolescence-limited type of CD; a perpetuating pattern of aggressive behavior or Antisocial Personality Disorder (APD) is almost always preceded by early onset DBD (Kim-Cohen et al., 2003).

Childhood aggressive behavior and early onset DBD are associated with a wide range of detrimental developmental consequences. Immediate negative outcomes such as rejection by peers resulting in social isolation, or poor school achievement mostly influence the child itself. However, the family of the child might also experience the adverse effects of the child's aggressive behavior problems, e.g., parents might be hindered in their daily functioning at work or at home (Romeo, Knapp, & Scott, 2006; Knapp, Scott, & Davies, 1999).

On the long term, developmental consequences worsen and negative effects are no longer limited to the individual and its family, but also affect wider society (Scott, Knapp, Henderson & Maughan, 2001). Substance abuse, unemployment, marital and relational problems, occupational difficulties, mental health problems or psychiatric disorders (e.g., depression and APD), criminality, and teenage pregnancy are examples of adverse outcomes, of which unemployment, psychiatric disorders, and criminality result in the highest costs for society due to the need for state benefits, mental health care use, and the costs of the justice system (Maughan & Rutter, 2001; Kim-Cohen et al., 2003). The high costs of aggressive behavior are illustrated by the findings of Scott et al (2001). Their study revealed that the costs of 10-year-old children diagnosed with CD on a parental interview were ten times higher by age 28 than costs of their typically developing peers (£70.019 vs. £7423), mainly due to criminal activities. Costs of 10-year-old children with conduct problems but without a diagnosis of CD (£24.324) were found to be already 3.5 times higher than for children without these problems. Cohen (1998) calculated the cost benefits of the prevention of a developmental trajectory of chronic aggressive behavior and the associated criminality in adolescence and adulthood, which resulted in savings up to $1.7 to $2.3 million per child.

Factors associated with development and persistence of DBD
Research has delineated several factors associated with the development and persistence of aggressive behavior and DBD; individual or biological factors and environmental factors, as well as the interaction between these two (Burke, Loeber & Birmaher, 2002; Rutter, Moffit & Caspi, 2006). The risk of negative developmental consequences of aggressive behavior exponentially increases with each additional risk factor (Loeber & Farrington, 2000; Sameroff, Seifer & Bartko, 1997). Children with aggressive behavior require a different approach from their caregivers (environment) than children without aggressive behavior. When individual and environmental factors are well-attuned, the risk for the development of DBD decreases. Similarly, protective factors might divert negative developmental outcomes and increase the resiliency of the child (Keller, Spieker & Gilchrist, 2005).

Individual factors
Individual or biological factors have been less extensively investigated than the environmental factors associated with aggressive behavior or DBD. However, several biological factors appear to be related to aggressive behavior in childhood.

Genetic influences
The hereditability of aggressive behavior is approximately 50% (Rutter et al., 2006). In their meta-analysis Rhee and Waldman (2002) found that genes account for 41% of the population variance in aggressive behavior. Genetic influences are assumed to be even larger in young children. In a study by Van den Oord, Verhulst and Boomsma (1996) genes accounted for 69% of the aggressive behavior in 3-year-old children. Moreover, young children are at greater risk for the development of DBD if one of the child's biological parents has APD (Kazdin, 1995). Despite this large inheritable component, gene-environment interaction seems to be more influential in the development of aggressive behavior problems. (Moffitt, 2005; Rutter et al., 2006). A genetic predisposition towards aggression is often indicative of a family or larger environment in which aggressive behavior is frequently shown. The genetic vulnerability and the aggressive environment both increase the risk for the child to behave aggressively. In contrast, a very supportive and non-aggressive environment might compensate for the genetic predisposition of the child.

Temperament
Temperament refers to a construct of multiple biopsychological aspects of personality, e.g., effortful control, extraversion and negative emotionality (Rothbart, Ahadi & Evans, 2000). Aggressive behavior and childhood temperament have been linked in several studies (Caspi, Henry, McGee, Moffitt & Silva, 1995; Guerin, Gottfried & Thomas, 1997; Nigg, 2006). In a longitudinal study by Caspi (2000) temperament (level of impulsivity, irritability, and attention problems) at age 3 predicted aggression, delinquency, and convictions at ages 18 to 21. Poor attentional control and impulsiveness appeared to be most important in the prediction of later antisocial behavior (Caspi, 2000). In addition, Lahey et al (2008) showed that conduct problems across childhood could be predicted from temperament measured during the first year of life.

Autonomic arousal
Low Autonomic Nervous System (ANS) activity (e.g., heart rate and skin conductance) has been associated with the persistence of aggressive behavior (Crowell et al., 2006; Lorber, 2004). Venables (1989) and Raine, Venables and Mednick (1997) demonstrated that skin conductance level at age 3 predicted aggressive behavior at ages 9 and 11. Raine (1993) suggested a possible explanation for these findings. He proposed that a low level of autonomic activity is related to fearlessness. The lack of fear could predispose these children to aggressive behavior; punishment would not evoke a fearful reaction, resulting in poor conditioning and impairment in the development of conscience.

Executive Functioning
Executive Functioning (EF) encompasses several neuropsychological concepts, e.g., inhibitory control, working memory, set shifting, and verbal fluency (Senn, Espy & Kaufman, 2004) and is primary located in the prefrontal cortex (Fahie & Symons, 2003). Impairment in EF is often found in children with aggressive behavior or DBD, especially when ADHD is also present. There is a continuing debate on the question whether EF impairments are related to ADHD, DBD or both (Morgan & Lilienfeld, 2000; Oosterlaan, Logan & Sergeant, 1998; Willcutt, Doyle, Nigg, Faraone & Pennington, 2005). In studies by Hughes, White, Sharpen and Dunn (2000), Hughes, Dunn and White (1998) and Speltz, DeKlyen, Calderon, Greenberg and Fisher (1999) deficits in inhibition, planning, and working memory were found in ag-

gressive preschool children. Finding these deficits at such a young age suggest that EF might play a crucial role in the development of aggressive behavior, for children who experience difficulties in self-control and emotion-regulation are more likely to persist in their aggressive behavior.

Cognitive abilities
Low IQ, especially low verbal IQ, is related to aggressive behavior (Farrington, 2005). A low level of intelligence predicts CD, delinquency, and adolescent antisocial behavior. Particularly, a large discrepancy between verbal and performance IQ is associated with the onset of aggressive behavior (Moffitt, 1993). Children with a low (verbal) IQ experience difficulties in school settings and complex social situations, and have limited capacities to express their emotions and to think of the consequences of their actions. This might lead to the use of aggressive strategies in reaction to peers or frustration. However, it is unclear whether this already affects very young children and whether differences in IQ between aggressive and typically developing children remain present when ADHD is controlled (Hogan, 1999; Moffitt, 2006).

Social information processing
Children with aggressive behavior have been found to process social information different from typically developing children (Crick & Dodge, 1994; Matthys & Lochman, 2005). For example, aggressive children attend to fewer cues from social situations, and are inclined to overestimate others' hostile intentions (Orobio de Castro, Veerman, Koops, Bosch & Monshouwer, 2002). They also come up with less (pro-social) solutions to social problems than their peers. In addition, in social conflict situation these children think more positively of aggressive solutions and tend to use aggression more often (Matthys & Lochman, 2005).

Environmental Factors
In addition to the individual factors mentioned above, several environmental factors are associated with the emergence and persistence of aggressive behavior or DBD. For some children aggressive behavior might be considered as part of the context in which they grow up.

Family and parenting
The family is one of the most important influences on a child's life and also the setting in which most risk factors for aggressive behavior and DBD are to be found. First, insecure attachment (avoidant as well as disorganized) is associated with an increased risk of aggressive behavior and DBD (Greenberg, Speltz, DeKlyen, & Jones, 2001). Children who have been neglected or rejected by their parents might be inclined to react aggressively out of fear or hostile expectations of others' behavior. In addition, parental rejection, physical or sexual abuse and parental neglect are predictors of DBD and later juvenile conviction or offending (Farrington, 2005).

Second, aggressive behavior problems tend to develop and persist in the context of harsh, inconsistent parenting and low levels of positive parenting (Gardner, Burton, Klimes, 2006). Ineffective parenting practices, such as physical punishment, unclear limit setting, poor parental supervision, lack of parental responsiveness and warmth, increase the risk of the development of aggressive behavior or DBD (Campbell, 2002; Côté et al., 2006, Côté, Vaillancourt,

Barker, Nagin & Tremblay, 2007; Webster-Stratton & Taylor, 2001). In contrast, the presence of positive parenting, e.g., monitoring, sensitive and supportive parenting, has been found to prevent DBD (Gardner, Sonuga-Barke & Sayal, 1999). Patterson (1982) has investigated mechanisms through which these parental practices operate. His 'coercive theory' suggests that parents and children reinforce each other's negative behavior in families of children with aggressive behavior. Noncompliance of the child to parental commands is reinforced by the parent giving in, resulting in a persistent or increasing pattern of negative reinforcement (Patterson, 1982, 2002).

Third, considering the inheritable nature of aggressive behavior, family members of a child with DBD might constitute an aggressive model for the child. Children learn behavior by observing others, e.g., parents and siblings, and might therefore think of aggressive behavior as a way of communicating to others. Moreover, some children are socialized in a family in which aggression is viewed as useful or appropriate, which increases the risk for the development of DBD or conduct problems (Farrington, Jolliffe, Loeber, Stouthamer-Loeber & Kalb, 2001). Similarly, high levels of family discord or conflict are also linked to child aggressive behavior problems (Farrington, 2005).

Fourth, parental stress and psychopathology (e.g., maternal depression or substance use) are associated with aggressive behavior and DBD of the child. Parental stress often leads to dysfunctional parenting practices and thus increases the risk for conduct problems (Morgan, Robinson & Aldridge, 2002). The association between parental psychiatric disorders and child aggressive behavior is also mediated by poor parenting practices; if mothers' depression makes her less responsive and more punitive to the child, the risk of DBD is increased (Campbell, Pierce, Moore, Marakovitz & Newby, 1996; Lahey et al., 1999; Nagin & Tremblay, 2001).

Peers
Children with aggressive behavior or DBD often demonstrate poor social skills and are therefore frequently rejected by peers, eventually resulting in social isolation (Loeber & Farrington, 2000). Social isolation might lead to associations with delinquent or antisocial peers, which is considered an important predictor of DBD or aggressive behavior, especially in adolescence (Farrington, 2005). Deviant or delinquent behavior might be learned by imitating antisocial peers and is facilitated by reciprocal encouragement.

School
Attending a high delinquency rate school predicts child delinquent behavior and a relatively high number of delinquent children attends these schools. These schools are characterized by unclear rules and a poor school commitment of the students (Farrington, 2005). In contrast, a highly organized school context in which academic efforts are emphasized and fair rules are consistently enforced might serve as a protective factor for child aggressive behavior (Gottfredson, 2001; Maughan & Rutter, 2001). In addition, poor parental involvement with the child's school and poor academic performance of the child can be seen as a risk factor for aggressive behavior (Loeber & Farrington, 2000; Webster-Stratton & Taylor, 2001).

Larger environment
DBD and aggressive behavior are often predicted by low family socio-economic status (Côté

et al., 2006; Lahey, Loeber, Burke & Rathouz, 2002; Nagin & Tremblay, 2001). Poor parental education, unemployment, and low income are inversely related to DBD (Lahey et al., 1999). Children who follow a trajectory of chronic aggressive behavior often come from poor neighborhoods (Ingoldsby & Shaw, 2002; Leventhal & Brooks-Gunn, 2000). Children with aggressive behavior or DBD often live in disadvantaged urban areas; they come from disorganized neighborhoods with high crime rates, or inner-city areas with poor levels of safety, housing and high levels of unemployment (Lahey et al., 1999; Farrington, 2005). Moreover, children from poor neighborhoods are more exposed to familial risk factors for aggressive behavior than peers from more prosperous neighborhoods (Schonberg & Shaw, 2007).

Links between factors associated with development and persistence of DBD
Webster-Stratton & Taylor (2001) have linked most of these factors in a model that stresses the importance of child-environment transactions (see Figure 1). Although the biological factors associated with aggressive behavior are not explicitly depicted in this model, it has to be recognized that these factors play an important role in the development and persistence of conduct problems. Risk factors at toddler- or preschool-ages might stem from ineffective parenting practices or negative parent-child interactions, difficult temperament or impulsivity, parental psychopathology and family stress. The combination of these factors might lead to poor social skills and rejection of the child in a peer- or school context, setting the stage for academic failure and interpersonal difficulties, exacerbating negative child behavior into early-onset conduct problems.
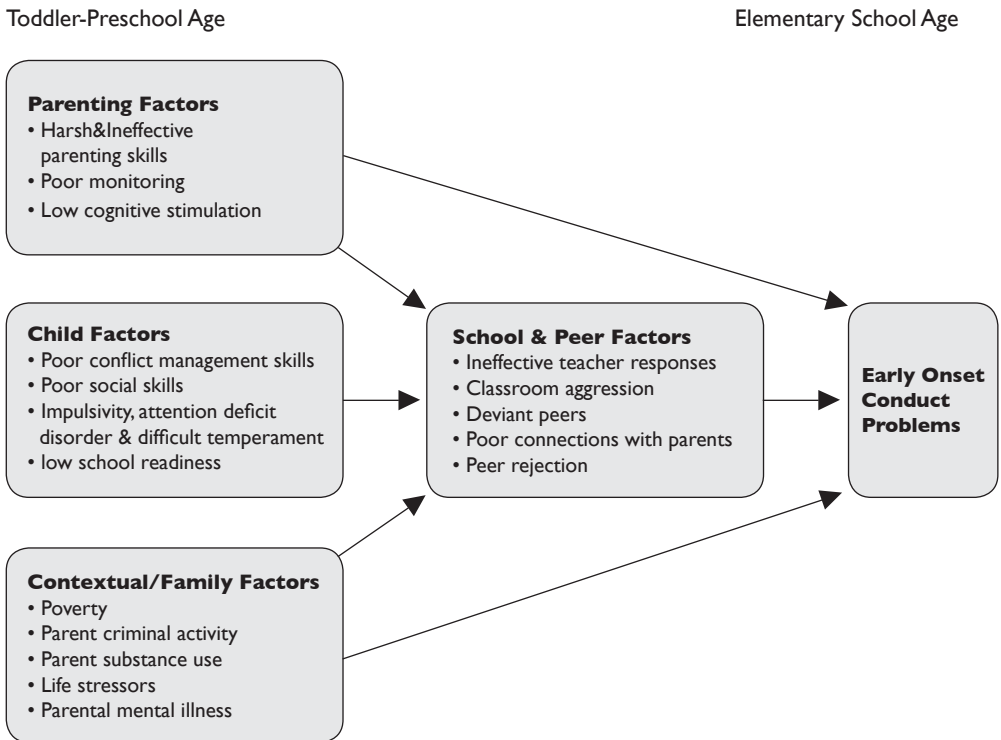
Toddler-Preschool Age   Elementary School Age

Fig. 1. Risk factors related to conduct problems (Webster-Stratton & Taylor, 2001)

Treatment of conduct problems and DBD

Although the majority of children who need treatment for conduct problems remains un-treated (Kazdin & Weisz, 2003), the benefits of several different interventions for young children with conduct problems or DBD have been well-established in previous research (e.g., Brestan & Eyberg, 1998; Eyberg, Nelson & Boggs, 2008; Nock, 2003). Positive effects have been confirmed for cognitive-behavioral therapy (Bennett & Gibbons, 2000), parent management training (Brestan & Eyberg, 1998; Serketich & Dumas, 1996), teacher training (Webster-Stratton, Reid & Hammond, 2004), or a combination of these approaches (Lochman & Wells, 2004). Initially, child therapy was the most common treatment for children with conduct problems or DBD. In the late 1960s, the focus shifted from child therapy to interventions with parents, aimed at changing parental behavior to reduce conduct problems (Kaminski, Valle, Filene & Boyle, 2008). More recently, with respect to young children, parent management programs appeared as the single most effective treatment for conduct problems or DBD (Brestan & Eyberg, 1998; Eyberg et al., 2008; Kazdin & Weisz, 1998; Lundahl, Risser & Lovejoy, 2006; McCart, Priester, Davies & Azen, 2006; Scott, 2002).

Evidence-based Parent Training Programs

As mentioned before, ineffective parenting practices are putative risk factors for the development and persistence of DBD in young children (Côté et al., 2006; Shaw et al., 2005; Tremblay et al., 2004). Young children are still heavily dependent on their parents for guidance and support (McCart et al., 2006), and therefore parental behavior has a large impact on child development. Parent training programs are generally aimed at improving adequate parenting skills and reducing the use of inadequate parenting skills. Parental behavior is modified in order to decrease aggressive child behavior and to increase prosocial child behavior (Kazdin, 1997, 2003). Most parent training programs are based on the social learning theory (Bandura, 1977) and Patterson's coercive theory (1982), and teach parents positive discipline techniques and how to avoid coercive interactions with their children (McCart et al., 2006; Webster-Stratton & Taylor, 2001).

Triple P-Positive Parenting Program

An example of an evidence-based parent training program for children aged 2 to 16 with behavioral and emotional problems is Triple P- Positive Parenting Program (Sanders, 1992; Sanders, Markie-Dadds, Tully & Bor, 2000). The Triple P program draws on social and developmental theories (Sanders, Markie-Dadds & Turner, 2003). This behavioral family intervention teaches parents child management strategies to promote children's competence (e.g., praise, quality time), and how to handle misbehavior of the child (e.g., ignore, setting rules). This intervention can be delivered in different levels of intensity (e.g., self-directed, standard, and enhanced), and strengths and format (individual or group) of the intervention are tailored to the needs of the family. All levels of intensity have been found to improve parent- and child outcomes (Sanders et al., 2000; Thomas & Zimmer-Gembeck, 2007) and these improvements were maintained at 3-year-follow up (Sanders, Bor & Morawska, 2007).

Parent Child Interaction Therapy

Another example of a parenting intervention that has been proven to be effective for young children (aged 2 to 7 years) with conduct problems is Parent Child Interaction Therapy (PCIT, Brinkmeyer & Eyberg, 2003; Eyberg, Boggs & Algina, 1995; Thomas & Zimmer-Gembeck, 2007). PCIT has been derived from attachment and social learning theories, and aims

to improve the quality of the parent-child relationship by changing the interaction between parent and child. PCIT is a two-phased therapy; first there is a part on Child Directed Interaction, focussing on playing with the child, and then a part on Parent Directed Interaction in which parents learn behavior management techniques while playing with their child. Parents first receive individual training and are then directly coached by a therapist behind a one-way screen while interacting with their child. This change in parent behavior is expected to improve the behavior of the child (Herschell, Calzada, Eyberg & McNeil, 2002). PCIT has been found to alter the parent-child interaction in a positive way (e.g., an increase in reflective listening and a decrease in criticism), and to significantly reduce conduct problems in young children (Hood & Eyberg, 2003; Nixon, Sweeney, Erickson & Touyz, 2003). Effects were maintained 1 to 3 years after termination of the intervention (Boggs et al., 2004).

Parent Management Training Oregon

Parent Management Training Oregon (PMTO; Patterson, Reid, Jones & Conger, 1975) draws mainly on the work of Patterson (e.g., Patterson & Reid, 1970) and was originally developed in the Oregon Social Learning Center. This is an effective behavioral parent training which promotes compliance and prosocial child behavior, and teaches parents noncoercive discipline, monitoring and contingent encouragement (Eyberg et al., 2008; Forgatch & DeGarmo, 1999). Parents of children aged 3 to 12 years learn how to modify their own behavior in order to improve child behavior. This parent program is delivered to families individually, and the number of sessions is adjusted to the requirements of the parents. PMTO has been found to reduce disruptive behaviors (Bernal, Klinnert, & Schultz, 1980; Patterson, Chamberlain & Reid, 1982). More recent studies into PMTO have been conducted in a preventive context or into specific subgroups of parents, e.g., single or divorced mothers. These studies revealed decreases in coercive parenting and improvement in positive parenting practices, resulting in enduring benefits for the child, e.g., a reduction of externalizing behavior problems and less noncompliance (DeGarmo, Patterson, Forgatch, 2004; Forgatch & DeGarmo, 1999; Martinez & Forgatch, 2001).

Incredible Years Parent Program

A final example of an evidence-based parent training program is the parent management training from the Incredible Years Videotape Modeling Program (IY; Webster-Stratton, 2001, 2002; Webster-Stratton & Hancock, 1998; Webster-Stratton & Reid, 2003). This program is based on social learning theory (Bandura, 1977) and the work of Patterson (1982) and is considered to be one of the most (cost-) effective evidence-based treatment interventions for parents of children aged 3 to 8 with aggressive behavior problems (Brestan & Eyberg, 1998; Scott, Spender, Doolan, Jacobs & Aspland, 2001; Spaccarelli, Cotler & Penman, 1992; Taylor, Schmidt, Pepler & Hodgins, 1998; Webster-Stratton et al., 2004). The IY parent program aims to increase positive parenting skills and prosocial child behaviors, as well as to reduce negative parenting and aggressive child behavior. Teaching methods such as watching video-vignettes, group-discussion, role-playing, modeling, and home assignments are used within a collaborative setting; group leaders establish themselves as part of the group, not as experts, to ensure that the progress made during the intervention is maintained following program completion. The IY parent program consists of two components; a BASIC component in which parenting skills are addressed, and an ADVANCE component, which focuses on communication and problem solving. Results of the studies mentioned above provide evidence for sustained intervention effects. Increased use of positive parenting skills (e.g.,

praise, play, limit setting, time out) and decreases of harsh and inconsistent parenting (e.g., less spanking, threatening, and yelling) were reported, resulting in less aggressive behavior of the child (Gardner et al., 2006; Reid, Webster-Stratton & Hammond, 2003; Webster-Stratton & Hammond, 1997).

Prevention of DBD

Considering that the origins of conduct problems are to be found in early childhood and that aggressive behavior patterns become more entrenched over time (Broidy et al., 2003; Shaw et al., 2005), intervention is required in an early stage of development. Most prevention programs are designed to reduce aggressive behavior in children in order to prevent the emergence of DBD and its detrimental effects.

Type of prevention

Although the importance of prevention of DBD is widely recognized, prevention is a complex matter. First, a choice has to be made on the population at which the preventive intervention is targeted. Universal prevention is aimed at an entire population, whereas targeted prevention is aimed at specific groups of children who are at risk for the development of disorders (Mrazek & Haggerty, 1994). Two types of targeted preventive interventions have been discerned. In selective prevention, children who are at high risk due to the presence of social, familial or psychological risk factors that are associated with the onset of a disorder are targeted by the intervention. Indicated prevention is targeted at children who are at high risk because of a predisposition for a disorder, e.g., biological markers, or at children who already show some symptoms of a disorder.

Screening

Second, and related to the type of prevention used, are issues concerning screening for children at risk or identifying those children who are most likely to benefit from an intervention. In universal prevention by definition subjects are not screened, resulting in less stigmatization. However, this also results in a high number of subjects who receive an intervention but who actually not need it, causing unnecessary high costs and relatively little effect on the children at highest risk. In contrast to universal prevention, targeted prevention does require screening, resulting in more effective interventions due to the more accurate identification of children at risk (Offord & Bennett, 2002). Despite this screening, the small effect sizes reported in evaluations of targeted prevention programs might still be due to the impact of children who are inaccurately identified as being at risk (false positives; Bennett, Lipman, Racine, & Offord, 1998). Accurate screening is essential for effective preventive interventions (Hill, Lochman, Coie, Greenberg, & Conduct Problems Prevention Research Group, 2004) and although early procedures of screening are comprehensive and costly, they will yield large savings on the long term (Offord & Bennett, 2002).

This is illustrated by a study into the effect of an indicated preventive intervention program for DBD in school-aged children (Fast Track: Foster, Jones & CPPRG, 2006). Retrospectively it was shown that almost half of the sample was inaccurately identified as being at risk, in spite of an extensive screening procedure. For the total sample of children only small effect sizes were found. However, in the group of children who were at highest risk of CD the preventive effect as well as the cost-effectiveness of the intervention was established (Foster et al., 2006). This study demonstrates that, despite the complexities of prevention,

preventive efforts aimed at aggressive behavior in children positively affect development into adolescence and adulthood, especially in high risk groups (LeMarquand, Tremblay & Vitaro, 2001; Tremblay, LeMarquand, Vitaro, 1999).

The Incredible Years Parent Program as a preventive intervention
The effectiveness of the IY parent program as treatment for children with conduct problems has been well-established in previous research (Gardner et al., 2006; Scott et al., 2001; Taylor et al., 1998; Webster-Stratton et al., 2004). However, the effect of the IY parent program as a preventive intervention is less consistent and less extensively investigated. Relatively few studies have evaluated the preventive effect of the IY parent program, and reported mixed results. Webster-Stratton (1998) conducted a study into the preventive effect of IY in the context of Head Start (disadvantaged families, living in poverty). Improvements in parenting skills were found on both parent-rated and observational measures, and these improvements were maintained to follow up one year after termination of the intervention. In addition, modest but significant improvements in child behavior were found on the observational measure. However, mothers and teachers did not report these improvements in child behavior. Therefore, in a review of successful and unsuccessful prevention trials (LeMarquand et al., 2001) the IY parent program as program was considered to be only partly successful and was labeled as a 'promising' preventive intervention.

Another study in the context of Head Start evaluated the preventive effectiveness of the IY parent- and teacher training (Webster-Stratton, Reid & Hammond, 2001). Improvements in parenting practices were found and teachers reported improvements of child behavior at school. With respect to improvement in child behavior at home a trend was found. However, when only parents who attended more than 50% of the IY sessions were taken into account, the effects on child behavior at home became significant, although effect sizes remained small. When children who were most at risk were examined as a subgroup, clinically significant reductions in conduct problems were found. These effects and effects for the total group were maintained at one-year follow-up.

A study into the preventive effect of IY in Wales (UK) evaluated the preventive effectiveness of the IY parent program for children aged 3 to 5 years with an aggressive behavior score at or above a clinical level in Sure Start areas (Hutchings et al., 2007). Significant improvements in parenting and child behavior were found on parent-reported measures with large effect sizes. Observed positive parenting practices were also significantly different in the intervention and control group, but observed reductions in negative parenting and improvements in child behavior did not reach statistical significance. The parent-reported reductions in disruptive child behavior were maintained at follow-up.

Brotman et al (2003, 2005, 2008) also investigated the preventive effect of the IY parent program. However, in these studies children were not at risk due to living in poverty or a disadvantaged situation, but due to having an adjudicated sibling or a family history of antisocial behavior. These studies revealed that parents became more responsive and less negative to their child. With respect to child behavior, the 2003-study showed parent-rated decreases in externalizing child behavior, the 2005-study reported greater observed social competence (no parent-rated measures of child behavior were included), and the 2008-study found positive intervention effects on the child's observed physical aggression, but not on parent-rated aggression of the child. In summary, findings on the preventive effectiveness of the IY parent training remain inconclusive.

Aim and outline of the thesis

High levels of aggressive behavior in early childhood have been shown to predispose children to a chronic and persistent pattern of conduct problems throughout their lives (Moffitt, 2002). Moreover, previous studies have provided evidence for the detrimental developmental consequences of aggressive behavior problems or DBD for individuals, their families and society (Rutter & Maughan, 2001). This gives rise to further research into correlates of aggressive behavior in young children and emphasizes the need for effective preventive interventions. Therefore, the aim of this thesis was to investigate neuropsychological correlates and costs of aggressive behavior, as well as to evaluate the preventive effectiveness of the Incredible Years parent program in a population-based sample of preschool children at risk for DBD. Four different studies were conducted and are presented in this thesis.

In **Chapter 2** we investigated executive functioning (EF) as a correlate of aggressive behavior. Deficits in EF have often been found in children with DBD, mainly in school-age children and adolescents, but this association is less clear in preschool children (Isquith, Crawford, Espy & Goia, 2005; Morgan & Lilienfeld, 2000). The high risk for DBD of children who show early onset aggressive behavior highlights the importance of the early detection of neuropsychological impairments. Six neuropsychological tasks were administered to a group of children with aggressive behavior and to a group of typically developing children to assess working memory, set shifting, inhibition and verbal fluency. A factor analysis was performed in order to explore the relations between these different executive functions in preschoolers. We expected that children with aggressive behavior would be more impaired in EF than their typically developing peers.

Research has shown that DBD incurs high costs to society and to the families of children with aggressive behavior. This finding is mainly established in school-age children and adolescents (Scott et al., 2001). In **Chapter 3** we investigated whether four-year-old children with highly aggressive behavior already generate higher costs than children with low levels of aggressive behavior. Service use of the children was reported by their parents, as well as damage done by the child. Costs of service use and damage of four groups of preschool children with different levels of aggressive behavior were compared and we hypothesized that the highest costs would be incurred by the groups of children with the highest levels of aggressive behavior. In addition, the impact of the aggressive behavior of the child on daily family functioning was assessed. Parents were asked to report whether they were hampered at work or in daily tasks by the aggressive behavior of their child. Our hypothesis in this regard was that children with high levels of aggressive behavior also had the largest impact on family functioning.

Parent Management Training (PMT) has been proven to be effective in reducing child conduct problems, especially when parents participate in a PMT when the children are young (Lundahl et al., 2006; McCart et al., 2006). Most studies into the effectiveness of PMT have been conducted in treatment settings and demonstrated positive results (Brestan & Eyberg, 1998; Eyberg et al., 2008; Thomas & Zimmer-Gembeck, 2007). The preventive effectiveness of PMT has been studied less extensively and yielded inconsistent results. However, if evidence for the effectiveness of PMT in a preventive setting can be provided, negative developmental as well as financial consequences can be averted. This stresses the importance of research into the effectiveness of preventive PMT and therefore we aimed to investigate the preventive ef-

fectiveness of the IY parent program. **Chapter 4** reports on the methodological aspects of our study into the intervention effect. In intervention research, randomized controlled trials are generally seen as the most optimal study-design. However, in practice randomization is not always feasible, e.g., due to geographical and motivational reasons as was the case in our evaluation of the preventive effectiveness of the IY parent program. We chose to use a case control design and intervention and control group were matched (person-to-person) on six key characteristics. In this chapter we report on the quality of this matching when compared to randomization.

In **Chapter 5** the evaluation of the IY parent program as a preventive intervention is described. Results on pre-, post- and follow up assessment (one year after termination of the intervention) are presented. We hypothesized that the IY parents program would improve parenting skills and that due to these improvements the aggressive behavior of the children in the intervention group would be decreased when compared to children in the control group who received only care-as-usual. In addition, mediating mechanisms and moderating factors were examined. In **Chapter 6** findings from the previous studies are summarized and implications for clinical practice are discussed, as well as recommendations for future research.

This thesis presents the first part of our research project. In addition to the studies presented here, autonomic arousal and social information processing were examined in the same sample of children. Moreover, the effectiveness of the IY parent program two years after termination of the intervention, as well as the cost-effectiveness of this parent program will be investigated. Results of these studies will be described in a future thesis.

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Chapter 2

Executive Functions in Preschool Children with
Aggressive Behavior: Impairments in Inhibitory Control
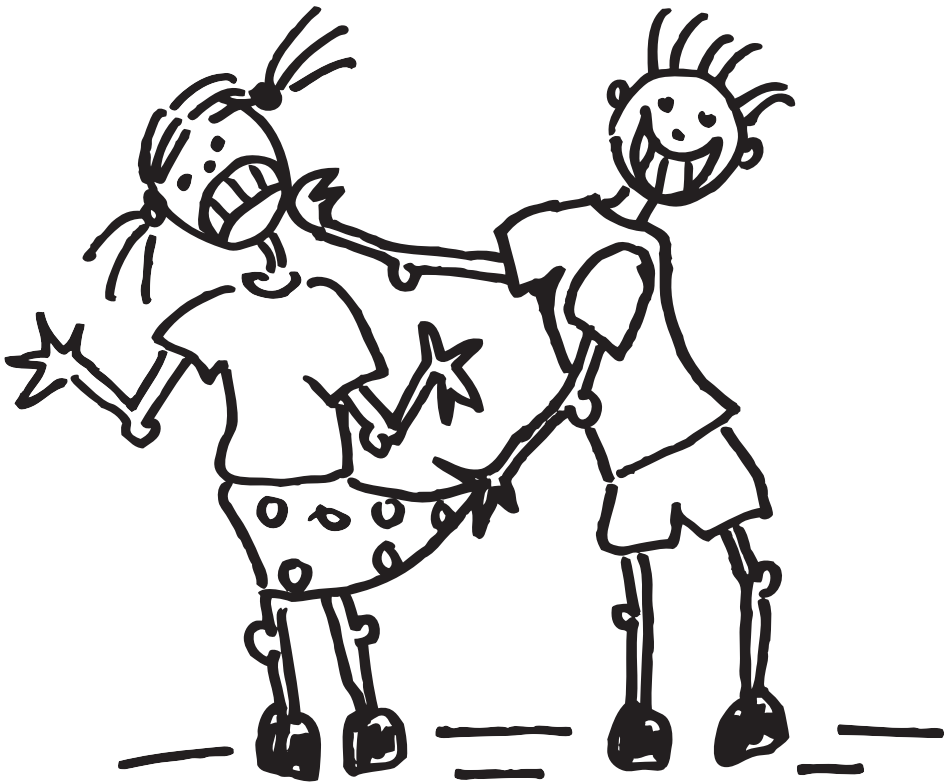
ABSTRACT

Background: The question whether Executive Function (EF) deficits in children are associated with conduct problems remains controversial. Although the origins of aggressive behavior are to be found in early childhood, findings from EF studies in preschool children with aggressive behavior are inconsistent. The current study aimed to investigate whether preschool children with aggressive behavior show impairments in EF.

Methods: From a population-based sample, 82 preschool children who were showing aggressive behavior as indicated by scores at or above the 93rd percentile on the Aggressive Behavior scale of the CBCL 1½ - 5 were selected. These children with aggressive behavior were matched on IQ to a group of typically developing control children (N = 99). Six neuropsychological tasks were administered to assess set shifting, inhibition, working memory and verbal fluency.

Results: A factor analysis was conducted which yielded one clear factor: Inhibition. Aggressive preschool children showed poorer performance on this Inhibition factor than control children and boys performed worse on this factor than girls. This association between aggressive behavior and inhibition deficits was maintained after controlling for attention problems. In addition, gender differences in all EF's measured were found with boys exhibiting more impairment in EF than girls.

Conclusion: These findings demonstrate that preschool children with aggressive behavior show impairments in inhibition, irrespective of attention problems.

INTRODUCTION

Executive Functioning (EF) refers to a set of higher order cognitive processes, which are involved in the self-regulation of thought, action and emotion (Séguin & Zelazo, 2005). EF processes are necessary for adaptive and goal-oriented behavior, and have been associated with the integrity of neural systems in the prefrontal cortex (Fahie & Symons, 2003). A number of different neuropsychological concepts are encompassed within EF, including inhibition, attentional control, working memory, cognitive flexibility or set shifting, goal setting and problem solving (Senn, Espy, & Kaufmann, 2004). Impairments in executive functioning (EF) have been linked to an impulsive behavioral style and the regulation of aggressive behavior (Séguin, Pihl, Harden, Tremblay, & Boulerice, 1995). Despite the fact that the origins of persistent aggressive behavior are to be found in early childhood (Shaw, Lacourse, & Nagin, 2005), only a few studies into EF have been conducted in preschoolers with aggressive behavior or conduct problems (e.g., Hughes, White, Sharpen, & Dunn, 2000; Senn, Espy, & Kaufmann, 2004). In this introduction, the relation between aggressive behavior and EF in elementary school children and adolescents is discussed first. Second, issues regarding the assessment of EF in young children are addressed. Third, several studies of EF in preschoolers who show aggressive behavior are reviewed and, finally, the aim of the study is presented.

Aggressive behavior and EF
Aggressive behavior and conduct problems are often defined in different ways, for example in terms of psychiatric disorders, such as Disruptive Behavior Disorders (DBD). The relation between EF and DBD has been studied (e.g., Morgan & Lilienfeld, 2000), but to a lesser extent than the relation between EF and Attention Deficit Hyperactivity Disorder (ADHD) (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Consequently, the association between ADHD and impairments in EF has been clearly established in research (Willcutt et al., 2005). In their review, Pennington and Ozonoff (1996) concluded that impairments in EF found in children with DBD were due to the presence of comorbid ADHD. Since then, this finding has been confirmed in several other studies (e.g., Clark, Prior, & Kinsella, 2000; Nigg, Hinshaw, Carte, & Treuting, 1998; Oosterlaan, Scheres, & Sergeant, 2005). However, in several other studies, the relation between aggression and EF impairments was maintained while controlling for ADHD (Déry, Toupin, Pauzé, Mercier, & Fortin, 1999; Séguin, Boulerice, Harden, Tremblay, & Pihl, 1999; Séguin, Nagin, Assaad, & Tremblay, 2004). Likewise, in a meta-analysis, Oosterlaan, Logan, and Sergeant (1998) concluded that deficits in response inhibition in children aged 6 to 12 years were not uniquely associated with ADHD, but also with Conduct Disorder (CD). In addition, children and adolescents with DBD have been found to show a dysfunction on EF tasks in which motivational processes are involved (Blair, Colledge, & Mitchell, 2001; Matthys, Van Goozen, De Vries, Cohen-Kettenis, & Van Engeland, 1998; Matthys, Van Goozen, Snoek, & Van Engeland, 2004; Van Goozen et al., 2004). In conclusion, EF impairments are to be expected in children and adolescents who show aggressive behavior disorders, irrespective of ADHD. It is unclear, however, whether this holds true for preschool children.

Assessment of EF in young children
Historically, young children have been assumed to lack executive capacities (Isquith, Crawford, Espy, & Goia, 2005). For this reason, studies into the EF of preschool children are relatively scarce and results are contradictory. Moreover, there is a paucity of measures to

assess EF in young children (e.g., Carlson, 2005; Espy, Kaufmann, Glisky, & McDiarmid, 2001). Only a few of the tests originally designed for older children, adolescents or adults that were adapted for 4-year-olds are completely developmentally appropriate for preschool children (Gerstadt, Hong, & Diamond, 1994; Isquith, et al., 2005; Kerr & Zelazo, 2004; Welsh, Pennington, & Groisser, 1991). Recently, the preschool period has gained attention with respect to the development of EF. During early childhood EF matures substantially, e.g., between 3 and 4 years of age improvements appear in response inhibition and the ability to think flexibly (Espy, 1997; Jacques & Zelazo, 2001).

However, no consensus exists concerning which EF's can already be distinguished in preschool children. Exploratory and confirmatory factor analyses have often been used to delineate components of EF in both adults and children (e.g., Hughes, 1998; Miyake et al., 2000). Welsh et al. (1991) suggested at least three executive factors: working memory and planning, inhibition of maladaptive prepotent responses, and self-monitoring or attentional flexibility. Senn et al. (2004) identified working memory, inhibition, and flexibility or shifting as latent executive constructs in a sample of preschoolers, which also have been used in previous studies (e.g., Pennington, 1997). A recent review on EF in preschool children shows that the EF components found most often were set shifting, working memory and inhibition (Garon, Bryson, & Smith, 2008). In confirmatory factor analyses, these three EF's were partially independent but still intercorrelated (Letho et al., 2003; Miyake et al., 2000). Therefore, EF can be viewed as a unitary construct with dissociable components in the preschool years (Miyake et al., 2000).

EF in preschool children with aggressive behavior
Studies which did investigate EF in young children who show aggressive behavior revealed impairments in inhibition of maladaptive prepotent responses (Hughes, Dunn, & White, 1998), deficits in planning and inhibitory control in a group of hard-to-manage preschoolers (Hughes et al., 2000), and impaired performance on a motor-planning and attention task and on a semantic classification and working memory task in a group of children who met the criteria for Oppositional Defiant Disorder (ODD), with and without ADHD (Speltz, DeKlyen, Calderon, Greenberg, & Fisher, 1999). In other studies of EF in preschoolers with aggressive behavior, the role of ADHD was taken into account more specifically. Results of these studies showed poor EF in children with DBD and comorbid ADHD, but the association between DBD and EF deficits did not remain significant, when the effect of ADHD was partialled out. For example, Kalff et al. (2002) showed that children with comorbid DBD and ADHD are more impaired in working memory than children with only DBD. Berlin and Bohlin (2002) and Sonuga-Barke, Dalen, Daley, and Remmington (2002) also found a relationship between deficits in inhibition and ADHD. More recently, Thorell and Wåhlstedt (2006) found that poor EF performance on inhibition, working memory and verbal fluency tasks was associated with symptoms of ADHD, but not with ODD symptoms. In that study, gender differences were also examined but no significant differences between boys and girls were found.

This study
To sum up, although the association between DBD or aggressive behavior, irrespective of ADHD, and impairments in EF has been established in elementary school children and adolescents, this association is less clear in preschool children. Yet, the question whether EF

impairments are related to disruptive behavior in preschool children is important, because of the high risk for antisocial behavior of children who show early onset aggressive behavior (Moffitt, 1993). The early detection of EF impairments might shed a light on the role of neuropsychological deficits in the development of behavior disorders. Therefore, the present study aimed to assess EF in a population-based sample of 4-year old children who show aggressive behavior. We hypothesized that preschool children with aggressive behavior problems display impairments in EF, compared to control children. Specifically, based on EF literature in school-age and preschool children, inhibition and working memory are expected to be most clearly impaired. Due to inconsistency (Klenberg, Korkman, & Lathi-Nuutila, 2001; Overman, 2004) and scarcity of studies into EF and gender differences, no hypotheses were formulated regarding possible gender differences.

A battery of tasks adapted for preschoolers was used to assess inhibition, working memory, set shifting and fluency. To identify reliable constructs of EF in this sample of young children a factor analysis was performed. Due to the lack of consensus about the definition of EF, especially concerning young children, and because relatively new EF tasks were used in this study, this factor analysis was needed to explore the relation between the different EF variables in preschoolers. In addition, we investigated whether potential EF deficits were due to aggression or attention problems, by partialling out the influence of attention problems. Based on studies into EF impairments in school-aged children and adolescents with conduct problems or aggressive behavior, we hypothesized that EF deficits are mainly explained by aggressive behavior, irrespective of attention problems.

METHODS

Participants

Subjects were selected from a population-based sample of Dutch children in the province of Utrecht. Children were acquired by the Office for Screening and Vaccination. All recruited children were born either in 2000 or 2001 and were 4 years old at the time of assessment. The sample of children used in this study was derived from a longitudinal study into the effect of an indicated preventive intervention, the Incredible Years Parent Training Program (Webster-Stratton, 2001). In this longitudinal study, neuropsychological measures were included as moderators to predict treatment-effect. Children were selected to participate if they scored at or above the 80th percentile of the Aggressive Behavior scale of the Child Behavior Checklist 1½-5 (CBCL; Achenbach, 2000; Dutch version by Verhulst & Van der Ende); 200 children who showed aggressive behavior were recruited. The present study investigates the neuropsychological performance in a subsample of these children cross-sectionally. We have chosen to include children who clearly show a high level of aggressive behavior and to compare these children to a group with very low levels of aggressive behavior. In this manner, the relation between aggression and EF impairments will become more explicit. Children who showed a high level of aggressive behavior, i.e., if the child scored at or above the borderline range (93rd percentile) of the CBCL Aggressive Behavior scale were selected to be in the group of children with aggressive behavior (AGGR) in this study. The Aggressive Behavior scale consists of 19 items, e.g., 'is disobedient' and 'punishment does not change his/her behavior' which are rated on a three-point scale by one of the parents. The AGGR group consisted of 82 children, 59 boys (72%) and 23 girls (28%). The CBCL was also used in the selection of control subjects, referred to as CONTR. This group was recruited by the

Office for Screening and Vaccination. For these 99 control children, 64 boys (64.6%) and 35 girls (35.4%), selection was based on a score below the 50th percentile on the Aggressive Behavior scale and the Attention Problems scale. The Attention Problem scale of the CBCL consists of 5 items, e.g., 'cannot concentrate' and 'cannot sit still', which are also rated on a three-point scale by one of the parents.

Characteristics of the AGGR and CONTR group are depicted in Table 1. Groups were matched on IQ. Children with an estimated full scale IQ below 80 were excluded from this study. None of the children used medication at the moment of assessment. With regard to treatment, 2 children in the AGGR group received psychosocial treatment in the past three months. In addition, parents of 14 children in the AGGR group consulted a youth care center or a child psychologist because of their child's behavior. Parents of the children in both groups were highly educated and did not significantly differ in their educational level. In the AGGR group 2.5% received primary education, 4.9% received secondary education, 29.6% received intermediate vocational education, 38.3% received higher vocational education and 24.7% went to university. In the CONTR group none of the parents received primary education, 6.1% received secondary education, 29.3% received intermediate vocational education, 30.3% received higher vocational education and 34.3% went to university.

Table 1 Sample Characteristics by Group

Measure	AGGR (N = 82)		CONTR (N = 99)	
	Mean	SD	Mean	SD
Age[*]	50.65	3.05	52.31	2.20
IQ	108.33	10.40	110.31	6.97
CBCL 1½-5				
Aggressive Behavior[*]	24.93	3.80	3.67	2.57
Attention Problems[*]	4.90	2.16	0.55	0.90
Total Problems[*]	65.82	16.69	12.88	10.02

Note. Age is depicted in months; CBCL scores are raw scores. [*] $p < .01$.

Procedure

All participants were individually assessed twice in their home environment. Both assessment-sessions took approximately 45 minutes. Across children, two different test-sequences were used to minimize the effect of fatigue and inattention on task performance. Tests were administered by trained experimenters using standardized instructions. On each home visit, two experimenters were present: one assessed the child and the other observed the child. Testing began when instructions were fully understood by the child. Children were asked to be accurate and as fast as possible (except on the Digit Span (words) and the OCTC); they were not informed of their errors. A HP Compaq Business Notebook NX 9110 was used to run the computerized tasks. The child looked at a Philips 15"LCD-monitor and had to push two large buttons which were converted emergency stop switches with an external diameter of 94 millimeters (MOELLER Safety Products; FAK-R/V/KC11/1Y). Written informed consent was obtained from the parents of the participating children. Parents completed a set of questionnaires and received a financial reward. Children received a small gift for their

participation. This study was approved by the Medical Ethical Review Committee of the Utrecht University Medical Centre.

Measures

Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R)
During the second assessment, the WPPSI-R (Wechsler, 1997; Dutch version by Vander Steene & Bos) was administered to the child to measure intelligence. Subtests Picture Completion, Vocabulary, Block Design and Similarities were used to estimate full scale IQ (correlation subtests with full scale IQ = .92), following the guidelines of Sattler (1992).

Go/No go
The Go/No go is a well-established measure of inhibitory control with adequate psychometric properties (Casey et al., 1997; Drewe, 1975; Picton et al., 2006). In this study an adaptation of the original Go/No go paradigm was used, adjusted to 4-year-old children (Smidts & Groot, 2003). Children were shown pictures of an elephant (Go-stimulus) or a dog (No go-stimulus) alternately on a monitor. Pictures were presented for 1500 milliseconds (ms) but disappeared when a response was given within this period. Trials were presented with a fixed inter-stimulus-interval (ISI) of 1500 ms. Inhibition was required in 50% of the trials, which were presented in a random order. The task commenced with 48 practice trials, followed by 48 trials which measured task performance. During the practice period the experimenter repeated the instructions to ensure that the child understood the task. Duration of the Go/No Go was approximately 5 minutes. Task performance was measured by the number of correct and incorrect inhibition responses, and the number of nonresponses.

Digit Span (words)
This task is an adaptation of the Digit Span (words) subtest of the Wechsler IQ Scale for Children (WISC; Wechsler, 1949) and was used to measure verbal working memory (Smidts, 2003). The Digit Span shows an adequate level of internal consistency (Elliot, 1990). The task required the child to repeat a string of words, which was read aloud. The forward condition started with two-word strings, which the child had to repeat. When the child repeated these words accurately, the strings were elaborated with one word, until a six-word sequence. In each trial, there were two strings of words; at least one of these strings had to be repeated correctly in order to proceed to the next trial. In the backward condition, the child had to repeat the words in reversed order. Again, in each sequence one word was added. Scores obtained from this task were the total number of words the child repeated correctly in the forward- and backward condition.

Shape School
Originally, the Shape School (Espy, 1997) is a colorful storybook, used to measure working memory, inhibition and switching processes. Espy, Bull, Martin, & Stroup (2006) found evidence of good validity and acceptable reliability for this task. In the present study, a computerized modified version of the test was used (Smidts & Groot, 2003). The task consisted of four conditions. First, the Control Condition in which the child had to push the button of the color of the figure that appeared on the screen (red or yellow). Second, the Inhibition Condition; the child had to respond by pushing the button of the correct color only when the figure looked happy, and to suppress this response when the figure looked sad. In these two conditions, each consisting of 24 practice trials and 24 trials to measure task performance,

there was a fixed ISI of 1500 ms. Figures were presented for 1500 ms, but disappeared when a button was pushed within this period. In the two following conditions, Switching and Both, the child had to retain and switch between rules. Again, each condition consisted of 24 trials, but these were now presented on the screen for 2000 ms with an ISI of 2000 ms. In the Switching Condition, the child had to respond to the color of the figure, but when the figure wore a hat, the child had to push the button of the contrasting color. In the Both Condition one rule was added; only push a button when the figure looked happy. In this last condition, the child had to inhibit a response when a sad figure was shown and to switch between rules from earlier conditions. Task performance was measured by the number of correct and incorrect responses, the number of correct and incorrect inhibition responses, and the number of nonresponses in each condition.

Verbal Fluency
The Verbal Fluency task was designed to measure working memory or semantic word fluency (Welsh et al., 1991). This task required the generation of as many words as possible in a specific category within a given time limit. Children were required to generate as much different examples of 'animals' and 'food and drinks' as they knew, within a time limit of 40 seconds. Two examples of each category were provided in the task instructions. Items named more than once and items from other categories were rated as incorrect. Scores obtained from this task were the total numbers of correct and incorrect examples the child named in each category.

Object Classification Task for Children (OCTC)
The OCTC (Smidts, Jacobs, & Anderson, 2004) was based on the Concept Generation Test for Children (Jacobs, Anderson, & Harvey, 2001). The OCTC is used to examine set shifting or cognitive flexibility. This sorting task required the child to group six pictures of planes and cars on common features in three different ways; color (red or yellow), function (plane or car) and size (big or small). The child was required to form two groups and was then asked for a verbal response on the common feature of the pictures, until all cards were sorted according to the groupings mentioned above. Two practice trials were given, to see whether the child was capable of forming two groups according to overall appearance. The OCTC was employed with two different settings, one with six pictures and one with four pictures. There were three conditions with increasing levels of structure; a Free Generation Condition, where the child had to group the pictures without assistance. For each correct sort, the child received three points. When the child was unable to sort the cards correctly, the setting with four cards was used. The three pictures of the planes were removed and replaced by a picture of a small yellow car, which allowed for sorts of color and size only. In both settings, the Identification Condition was next, in which the experimenter grouped the pictures and the child had to identify the sort. In this condition, two points were given for a correct answer. If the child failed this condition, the experimenter went on to the third condition, Explicit Cueing. The child was explicitly told how to group the pictures. One point was awarded for a correct sort and one point was also given for each correct verbal response. The summed total of points was used as an indication of the child's ability to shift between concepts.

Day-Night task

The Day-Night task is a well-validated measure of prepotent response inhibition and working memory in young children (Diamond, Kirkham, & Amso, 2002; Gerstadt, et al., 1994). The task requires the child to keep two rules in mind and to inhibit an automatic response. In this study, the experimenter showed the child sixteen cards in a fixed order with either a sun with a blue background, or a white moon and stars with a black background. To ensure that the children adopted a set of prepotent responses, a control condition was administered. In the control condition children had to say "day", when the card with the sun was shown, and "night", when the card with the moon was shown. In the experimental condition, the rules were reversed; the child had to say "day", when it saw the card with the moon, and "night" to the card with the sun on it. A practice trial was administered in each condition, with a maximum of three trials, in which the child had to respond correctly to two cards. Scores obtained by this task were the total number of correct and incorrect responses, the number of self-corrections.

RESULTS

Data analysis

Missing data were primarily the result of children who failed to understand task instructions or whose assessment could not be completed due to extreme inattentive or noncompliant behavior. A score of 0 was only given, when the child had attempted the task and then failed. Groups were matched on IQ. The AGGR and CONTR group differed significantly on age (see Table 1); therefore age was used as a covariate. First, a factor analysis was performed on data of all children. Second, ANCOVA's were conducted using a factorscore and other task variables, in which both group and gender were used as between-subject-factors. All analyses were performed using SPSS 15.0 (2006).

Factor analysis

To explore the relation between EF variables, scores from the neuropsychological tasks were submitted to an exploratory factor analysis. Principal Axis Factoring (PAF) was performed on 10 variables from different neuropsychological tasks. For this factor analysis, one variable of each task was chosen to prevent an artificial clustering of variables from the same task. To investigate impairments in EF, the number of incorrect responses of the child was used as main outcome variable. However, not every EF task used was designed to measure the number of incorrect responses, especially not the manually administered tasks. Therefore, we used the number of incorrect responses the children gave on the computerized tasks and for the manually administered tasks, we employed the number of correct responses. Using the number of correct responses of the computerized tasks yielded a comparable factor solution, but factors could less clearly be distinguished. Therefore, we chose to include the number of correct responses on the manually administered task and the number of incorrect responses on the computerized tasks.

A PAF followed by varimax rotation was performed and three factors with eigenvalues greater than 1 were extracted. This solution accounted for 33.13 % of the variance. Orthogonal and oblique rotation resulted in the same factor solution. Item loadings of .40 or higher are depicted in Table 2. The first factor accounted for 16.67 % of the variance, with factor loadings pointing to errors of commission on the inhibition trials in several computerized

tasks. Therefore, this factor, measuring impairments in inhibition, was labeled 'Inhibition'. The internal consistency of this factor was .69. The second factor accounted for 8.87 % of the variance and consisted of only one item, measuring both working memory and set shifting. This task variable, the number of incorrect responses of the Shape School Both condition, was analyzed separately. The third factor accounted for 7.66 % of the variance and consisted of variables from three manually administered tasks. The internal consistency of this factor was .39. Factor loadings are depicted in Table 2. Due to the low percentage of explained variance of the factor analysis and the low internal consistency of the third factor, we decided to include only the Inhibition factor in the analysis. All other tasks variables were analyzed separately.

Table 2 Item Loadings of the Rotated Factor Matrix

Variable	Factor 1	Factor 2	Factor 3
SS Inh: incorrect inhibition	.783		
SS Inh: incorrect	.558		
GNG: incorrect inhibition	.537		
SS Both: incorrect inhibition	.488		
SS Both: incorrect		.701	
OCTC correct			.488
DS correct			.481
VF correct			.413

Note. SS Inh = Shape School Inhibition condition; GNG = Go No Go; SS Both = Shape School Both condition; OCTC = Object Classification Task for Children; DS = Digit Span (words); VF = Verbal Fluency.

ANCOVA's

Significant correlations were only found between variables included in the Inhibition factor. Therefore, one-way ANCOVA's with age as a covariate were carried out to compare performance of the AGGR group on the Inhibition factor and the other task variables to the CONTR group (see Table 3). To conduct the ANCOVA on the Inhibition factor, a factorscore was constructed by transforming the inhibition variables from different tasks into standardized scores. This z-score transformation enhances the comparability among the variously scored tasks. Next, the Inhibition factorscore was computed by dividing the total standardized score of the four variables by the number of variables included in the factor. Group and gender were entered in the analysis as between-subject-factors. Means, standard deviations and the results of the ANCOVA's of the Inhibition factor and of the other task variables are displayed in Table 3, for group and gender. Effect sizes were also calculated (see Table 3), using Cohen's *d*; .2 indicates a small effect, .5 a medium effect and .8 a large effect size (Cohen, 1992).

The factorscore for Inhibition was included in the first ANCOVA. The four variables that were included in the factorscore were examined in subsequent analyses. Effects for both group and gender were found to be significant on the Inhibition factor and showed medium effect sizes. For group, other variables that yielded significant effects were only the variables included in the Inhibition factorscore. Age as a covariate did not affect the results on the Inhibition factor. Moreover, inspection of the data pointed out that the difference in inhibition scores was not affected by the distribution of age over the groups. The group effects on the Inhibition factor, and on variables included in this factor, pointed in the expected direc-

tion, with the AGGR group demonstrating more incorrect inhibition-trials than the CONTR group. This implies that the AGGR group was significantly more impaired in inhibition than the CONTR group. In addition, the Pearson product-moment correlation between the Aggressive Behavior score of the CBCL and the Inhibition Factor was computed (r = .287, p = .00), which implies that a higher aggressive behavior score was associated with more impairments in inhibition. Gender effects were also found on the Inhibition factor, and on the task variables included in this factor, with girls outperforming boys.

Unlike the effects of group, the effects of gender were not limited to tasks measuring inhibition. Significant gender effects were also reported on the Verbal Fluency task and the number of errors in the Shape School Switch condition, with medium effect sizes. Girls performed better than boys on these task variables. In addition, the effect of gender was marginally significant for the OCTC, but the effect size was smaller than for the other significant effects of gender. Again, girls were outperforming boys. Only one significant interaction effect for group and gender was manifested, i.e., the number of errors on the Shape School Switch condition (Group x Gender, F (1, 181) = 9.91, p = .00). Covarying for age did not yield significant effects on any task variable, except for the Digit Span (words) (Age, F (1, 181) = 5.61, p = .02). No significant results for group or gender were found on this variable.

To control for the influence of Attention Problems, ANCOVA's were also carried out with Attention Problems as an additional covariate. The Inhibition score remained significant for group (Group, F (1, 181) = 5.27, p = .02) and gender (Gender, F (1, 181) = 10.66, p = .00). The significant effect of group for the number of errors on the Shape School Inhibition condition was also maintained (Group, F (1, 181) = 5.95, p = .02). The effect of group for the variable Shape School Inhibition incorrect responses disappeared and the effect of the Go/No go did not yield significant results for group anymore.

DISCUSSION

The aim of the current study was to examine EF in preschool children with aggressive behavior in a population-based sample. Our findings demonstrated that preschoolers who show primarily aggressive behavior displayed impairments in inhibition. In this group of aggressive preschoolers these impairments in inhibition were maintained after controlling for attention problems. In addition, gender differences in EF were found, with boys exhibiting more EF deficits than girls.

We first examined which EF could be distinguished in this non-clinical sample of preschool children by factor analysis. Although the neuropsychological tests in this study were aimed at assessing working memory, inhibition, fluency, and set shifting, the only EF factor, which could clearly be distinguished was Inhibition. The other EF could not be distinguished as separate constructs. This implies that the differentiation of EF at this young age remains a complicated issue (Senn et al., 2004). EF is still maturing in the preschool period and will to develop into more specific functions. Considering the complexity of the construct of EF in the preschool years, the finding of inhibition as the only EF factor in the present study indicates that inhibition is a robust concept of EF at four years of age.

An explanation for identifying only inhibition as an EF factor is that inhibition is one of the

Table 3 Mean Scores and Standard Deviations by Group and Gender

Measures	AGGR				CONTR				Group			Gender		
	Boys		Girls		Boys		Girls							
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F	p	d	F	p	d
Factorscore Inhibition	0.34	0.93	-0.09	0.71	-0.85	0.52	-0.36	0.29	9.90	.00	.57	10.31	.00	.57
SS Inh: incorrect	1.41	2.13	0.70	1.49	0.73	1.00	0.49	1.04	4.40	.04	.35	3.49	.06	.33
SS Inh: incorrect inhibition	2.25	3.43	1.39	2.86	0.95	1.67	0.46	1.25	6.50	.01	.48	2.92	.09	.31
SS Both: incorrect inhibition	2.47	3.31	0.70	1.02	1.75	3.27	0.37	0.88	2.10	.15	.25	11.95	.00	.66
GNG: incorrect inhibition	3.00	3.16	2.22	3.15	1.66	2.21	0.91	0.92	7.26	.01	.54	3.78	.05	.35
VF correct	6.58	2.62	8.04	3.61	7.27	3.32	8.54	3.44	0.33	.57	.23	7.80	.01	.43
DS correct	4.88	1.85	5.17	2.19	5.47	2.03	5.69	2.14	0.84	.36	.29	0.87	.35	.14
DN correct	10.12	4.26	11.74	3.41	11.91	4.23	12.20	3.64	2.25	.14	.36	2.21	.14	.25
OCTC correct	6.02	1.68	6.96	1.94	6.39	1.44	6.46	1.50	0.14	.71	.08	3.85	.05	.28
SS Both: incorrect	3.69	2.65	2.83	2.73	3.80	2.97	3.77	3.18	0.89	.35	.12	0.87	.35	.12
SS Switch: incorrect	6.76	4.58	2.39	3.19	3.80	3.65	3.49	4.04	1.53	.22	.44	13.18	.00	.53

Note. ANCOVA Group x Gender; Age = covariate. The Inhibition factorscore is based on z-scores and a high factorscore implicates poor performance; p-values are two-tailed; SS Inh = Shape School Inhibition condition; SS Both = Shape School Both condition; SS Sw = Shape School Switching condition; GNG = Go No Go; VF = Verbal Fluency; DS = Digit Span (words); DN = Day Night task; OCTC = Object Classification Task for Children.

first EF to emerge (Barkley, 1997; Brocki & Bohlin, 2004). The ability to inhibit prepotent responses generally increases significantly over the preschool period, which is necessary for the exertion of control over one's behavior (Espy, 1997). Therefore, it appears to be a prominent feature in this period of rapid cognitive development, whereas other EF cannot yet be clearly detected at this young age and develop over time (Korkman, Kemp, & Kirk, 2001). Aggressive behavior was only found to be associated with impairments in inhibition and not in other EF. In the meta-analysis of Oosterlaan et al. (1998) and in the study of Hughes et al. (1998) deficits in inhibition were also related to aggressive behavior problems. Inhibition problems constitute a key characteristic of aggressive behavior problems and are found to be persistent over time (Brophy, Taylor, & Hughes, 2002). Although the relation between inhibition problems and DBD is well established in school-aged children, adolescents and adults (Morgan & Lilienfeld, 2000), finding this relation in a sample of young children who show aggressive behavior is important, because it might be that inhibition plays a crucial role in the developmental trajectories of aggression.

In contrast to evidence suggesting that EF deficits in preschoolers with aggressive behavior are mainly explained by symptoms of ADHD (e.g., Sonuga-Barke et al., 2002; Thorell & Wåhlstedt, 2006), this study reported results which demonstrated that inhibition deficits were significantly related to aggressive behavior, irrespective of attention problems. Attention problems did not influence the effect of aggression on the Inhibition factor. It should, however, be specified that the level of attention problems was relatively low in the present sample. These findings are consistent with the notion that when problems concerning the inhibition of behavior arise, the risk of the development of aggressive behavior is increased (Kochanska, Murray, & Harlan, 2000). However, even in young children who primarily show aggressive behavior, attention problems remain important because of deficits in working memory and set shifting.

Gender differences in inhibition, verbal fluency, working memory and set shifting were found irrespective of aggression or attention problems. These findings contrast with studies of Overman (2004) and Thorell and Wåhlstedt (2006), in which no differences in EF of boys and girls at this age were manifested. However, gender differences in effortful control, i.e., the ability to inhibit a dominant response to perform a non-dominant response have often been reported. Kochanska et al. (2000) found gender differences with girls outperforming boys in inhibiting impulsive responding, at ages as young as of 22 and 33 months. Olson, Sameroff, Kerr, Lopez and Wellman (2005) reported a significant effect for gender; girls showed higher levels of effortful control than boys at age 3. The more rapid developmental maturation of girls (Keenan & Shaw, 1997) might be responsible for their higher level of inhibitory skills and other EF in the preschool period and could explain why preschool boys make more mistakes on EF measures. Especially the relative delay in inhibition of preschool boys makes them more prone to the development of aggressive behavior. In further research it is important to study the inhibitory skills of large samples of boys and girls separately in order to more clearly detect gender differences. We also found a difference between boys and girls in verbal fluency, with girls being more verbally fluent than boys. This is relevant as poor verbal skills compose a risk factor for the development of aggressive behavior problems (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). Children at high risk for DBD are children who experience difficulties regarding both executive and verbal cognitive skills (Moffitt, 1993). In addition, socialization practices might contribute to gender differences in inhibition. In gen-

eral, girls are encouraged to exert more control over their behavior than boys (Keenan & Shaw, 1997). As a result, girls learn to show more inhibited behavior than boys from an early age on, which might be reflected in our findings. Finally, the marginally significant effects of gender on other EF might be due to a lack of statistical power, because the number of girls in this sample was relatively small. Therefore, EF such as working memory and set shifting also require to be analyzed separately for boys and girls in future studies.

This study has a number of limitations that need to be considered. First, the majority of the parents of the children in our sample showed a high educational level. Therefore, our findings have limited generalizability to children from less educated parents. Second, we employed extreme inclusion criteria. We compared a group of children who showed a low level of aggressive behavior to a group of children who showed a relatively high level of aggressive behavior; these groups represent the extreme ends of the behavioral spectrum. The finding of EF impairments in the aggressive group can only be interpreted within this context. Third, we used an experimental battery of tasks, consisting of six neuropsychological measures. The use of other EF measures might have yielded different EF factors, and might thus have captured other EF deficits present in this group of young aggressive preschoolers. An additional limitation is that the measures used did not assess 'pure' EFs; most EF tasks measured more than one EF. Tapping pure EFs is conceptually not feasible, because almost every task requires a subject to keep rules in mind and thus addresses working memory next to the EF which was aimed to be measured. By conducting a factor analysis, we deducted the common variance between the variables from the measures used, resulting in a latent Inhibition factor that represents a more pure measure of EF. The use of tasks which assess the more motivational aspects of EF are of interest, considering that school-aged children and adolescents with DBD show dysfunctions on these kinds of tasks (Blair et al., 2001; Matthys et al., 1998, 2004; Van Goozen et al., 2004). Future studies are needed to clarify the role of reward and the more affective aspects in the EF of children who show aggressive behavior in this young age group.

The relevance of assessing EF in the preschool years is clearly supported by the current findings. Results of this study show that impairment in inhibition is a correlate of aggressive behavior in preschool children, regardless of attention problems. This study adds to the growing body of literature on the role of neuropsychological deficits in the development of behavioral disorders. Since inhibition deficits may contribute to the development of aggressive behavior and DBD, future research should assess EF in aggressive preschoolers longitudinally to gain insight in the role of EF deficits as precursors or risk factors for the development and persistence of DBD.

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Chapter 3

Cross-sectional study into the costs and impact on family functioning of 4-year-old children with aggressive behavior

ABSTRACT

Background: Early-onset aggressive behavior is known for its negative developmental consequences, resulting in high costs for families, the health care system and wider society. Only a few studies looked into the costs incurred by aggressive behavior of preschool children. The present study aimed to investigate whether 4-year-old children who are considered to be at risk for Disruptive Behavior Disorders because of a high level of aggressive behavior already differ in impact on family functioning and costs of service use from children with lower levels of aggression.

Methods: A population-based sample of 317 preschool children was recruited and divided into four groups with different levels of aggressive behavior (low, moderate, borderline and clinical) as indicated by their scores at the Aggressive Behavior scale of the CBCL 1½-5. A questionnaire was administered to their parents to assess the impact on family functioning. Parents were also asked to report lifetime service use of the child and which services were used by their child and themselves over the past three months.

Results: Families of children with a borderline or clinical level of aggressive behavior reported more impairment in their daily functioning than families of children with lower levels of aggression. Over the past 3 months as well as over the first four years of life, children with a clinical level of aggression were more costly than children with a low level of aggression, due to higher costs of services used by the child.

Conclusion: These findings demonstrate that a high level of aggressive behavior results in high costs and impaired family functioning in the preschool years already.

INTRODUCTION

Disruptive Behavior Disorders (DBD), a term which covers both Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD; APA, 2000) are known for their negative developmental outcomes, e.g., high school drop-out, substance abuse, delinquency and unemployment (Maughan & Rutter, 2001). These negative outcomes have large financial implications for families of children with DBD, the (mental) health care system and wider society.

Several studies have investigated the financial consequences of DBD in school-aged children and adolescents. In the study by Scott, Knapp, Henderson and Maughan (2001) costs of 10-year-old children diagnosed with CD on a parental interview were ten times higher by age 28 than costs of their normally developing peers, mainly due to criminal activities. Costs of 10-year-olds with conduct problems but without a diagnosis of CD were found to be 3.5 times higher than for children without these problems. In line with this study, Foster, Jones and the Conduct Problems Prevention Research Group (2005) found that costs of adolescents with CD were substantially higher than for adolescents with ODD or conduct problems over a seven-year-period. Results of a pilot-study into the costs of ten children aged 4 to 10 who had been referred to child and adolescent mental health services suggest that the costs of CD are already high at younger ages, due to increased utilization of health, social, and educational services (Knapp, Scott & Davies, 1999). High rates of service use account for a considerable part of the costs associated with DBD and conduct problems. Since patterns of service use tend to be stable over time (Lavigne et al., 1998; Leventhal, Brooks-Gunn, McCormick & McCarton, 2000), these patterns may predict utilization of services at later ages (Vostanis, Meltzer, Goodman & Ford, 2003).

It is important to investigate whether service use and costs of young children with aggressive behavior are already high at a young age. Since high levels of aggressive behavior tend to be stable and persistent over time (Frick & Loney, 1999; Shaw, Lacourse & Nagin, 2005; Tremblay et al., 2004), effective preventive interventions for these children may have long term benefits and the costs of such interventions may be outweighed by the long term savings. Two studies have been conducted in young children with a relatively large age range. In a study into the association between psychopathology and health care use in children aged 2 to 5 by Lavigne et al (1998) it was shown that externalizing problems were significantly related to increased use of health services. A more recent study (Romeo, Knapp & Scott, 2006) corroborates these findings. Children aged 3 to 8 who were referred for antisocial behavior showed high utilization rates of health, educational and social services, which resulted in high costs. Importantly, this study also revealed that these children imposed a substantial burden on their families, e.g., by extra time their parents spent on household tasks.

The present study aimed to examine whether 4-year-old children with high levels of aggressive behavior differ in their rate of service use and associated costs, and in the burden on the family compared to children with lower levels of aggression. To investigate whether aggressive preschool children already generate high costs, we assessed service use and estimated costs over the past three months and the first four years of life of children who ranged from low to clinical levels of aggression. We hypothesized that children who showed high levels of aggressive behavior would use more services, resulting in higher costs than children who showed normative levels of aggression. In addition, parental service use was assessed, because parents of children with behavior problems often report using more services than parents of typically developing

children, due to their child's behavior (Knapp, Scott & Davies, 1999). We expected that the service use of parents of highly aggressive preschool children would be higher than the parental service use of less aggressive children. Impairments in daily functioning of the parents due to the behavior of the child, e.g., extra time needed for daily household tasks, absenteeism at work, and damage done by the child were also assessed. In this regard, we hypothesized that parents of children with high levels of aggressive behavior were more impaired in their daily functioning than parents of children with a low level of aggression and that the most damage would be done by children who showed high levels of aggression.

METHODS

Participants

Data were collected on 317 children who were enrolled in a study into the preventive effect of an intervention for parents of preschool children who show aggressive behavior. Children were selected from a Dutch population-based sample in the province of Utrecht. The addresses of the children were acquired by the Office for Screening and Vaccination. All recruited children were born either in 2000 or 2001 and were 4 years old at the time of assessment. Children's level of aggression was measured by the Child Behaviour Checklist 1½-5 (CBCL) Aggressive Behavior scale (Achenbach & Rescorla, 2000; Dutch version by Verhulst & Van der Ende). Children were divided into four groups; a group with a low level of aggressive behavior (scores at or below the 80th percentile), a group with a moderate level of aggressive behavior (scores above the 80th and below the 93rd percentile), a group with a borderline level of aggressive behavior (scores at or above the 93rd percentile, but below the 97th percentile) and a group with a clinical level of aggressive behavior (scores at or above the 97th percentile). Descriptives of these four groups are displayed in Table 1. The child's gender and IQ did not significantly differ between the groups, but age did (F (3, 316) = 5.432, p = .00).

Table 1 Sample Characteristics by Group

Measure	LOW (n = 189) M (SD)	MOD (n = 56) M (SD)	BORD (n = 25) M (SD)	CLIN (n = 47) M (SD)
Child				
Gender (% boys)	61.4	57.1	72.0	78.7
Age (months)	51.8 (2.27)	51.2 (2.45)	51.5 (3.24)	50.1 (3.26)
IQ	109.3 (11.90)	108.6 (9.77)	108.9 (10.74)	105.1 (11.11)
CBCL 1½-5 (raw scores)				
Aggressive Behavior	6.8 (4.52)1	8.0 (1.52)	22.0 (0.89)	27.8 (3.66)
Attention Problems	1.6 (1.73)	4.2 (2.14)	5.4 (2.26)	6.7 (2.12)
Parent				
N				
Mother	188	56	25	46
Father	176	48	23	44
Age (years)				
Mother	35.6 (4.18)	35.0 (6.25)	35.3 (3.59)	34.1 (4.48)
Father	38.0 (4.75)	37.1 (4.60)	37.6 (4.20)	37.4 (6.01)
Education (%)				
Primary	1.1	-	-	2.1
Secondary	3.2	3.7	8.0	4.3
Intermediate vocational	28.9	42.6	20.0	29.8
Higher vocational	34.8	31.5	28.0	38.3
University	32.1	22.2	44.0	25.5

Note. LOW = low levels of aggression; MOD = moderate levels of aggression; BORD = borderline levels of aggression; CLIN = clinical levels of aggression.

Procedure

Written informed consent was obtained from the participating families. A set of questionnaires was mailed to the parents. Parents received a monetary reward of € 20,- for their participation. The study was approved by the Medical Ethical Review Committee of the Utrecht University Medical Center.

Measures

Questionnaire on Work and Costs

To collect information on impairment in daily functioning of the parents, a questionnaire based on the Health and Labour Questionnaire (HLQ) (Hakkaart-Van Roijen & Essink-Bot, 1999; Van Roijen et al., 1996) was adapted (see Appendix C). Employment status, absenteeism at work due to the child's behavior, extra time and help needed for housekeeping, for activities with the child and for doing chores were assessed. In addition, the costs of damage done by the child were. The questionnaire consisted of 12 questions that were asked about the past three months or the past two weeks. Both mothers and fathers filled out this questionnaire.

Data on service use

Data on service use of the child due to aggressive behavior problems over the past three months and over the first four years of life were collected retrospectively. Additional data on service use of the parents in the past three months were also collected. Parents were asked to report which types of services were used by their children and themselves and about the frequency of consultations. Nineteen different service types were categorized into the following domains: medical care (General Practitioner (GP), specialist services, physiotherapist, speech therapist, language centre, health visitor and alternative medicine), mental health care (child psychologist, psychologist psychiatrist, mental health services (day treatment or outpatient treatment)), youth care (regional child care, social work, service for the learning disabled, medical day nursery, special needs day nursery, child care & protection board) and educational care (educational services) of the children. The use of medical care (GPs, specialist services, company doctor, physiotherapist, alternative medicine), mental health care (child psychologist, psychologist psychiatrist, mental health services) and community care (social work) of the parents over the past three months was also assessed. Service use was assessed in different manners over four years and three months. Over three months, parents were asked to fill out the number of consultations. Over four years, parents reported the frequencies of utilization of services in four categories, 0-5, 6-10, 11-15, and more than 15 consultations. In our calculations we used the absolute values 3, 8, 13, and 16 for these four categories respectively.

Cost calculation

Service cost estimates were based on figures published in Oostenbrink, Bouwmans, Koopman-schap, & Rutten (2004), on information from health insurance companies, personal communication with service providers and the Internet. All costs were calculated in Euros at 2004 price levels (see Table 2). To generate service costs for each participant, cost estimates for each service type were combined with our data on service use. Only mother reports on child service use were included in this study. Service use by parents themselves was reported for mothers and fathers separately.

Table 2 Classification of Services & Unit Costs

Service	UnitCost Estimate	Source
Child		
Medical care		
General Practitioner	€ 20,20	Oostenbrink, 2004
Specialist services	€ 78,00	Oostenbrink, 2004
Physiotherapist	€ 21,50	Website[1]
Speech therapist	€ 25,60	Website[2]
Language centre	€ 80,00	Personal communication
Health visitor	€ 44,42	Personal communication
Alternative medicine	€ 80,00	Health Insurance Company
Mental Health care		
Child psychologist	€ 62,50	Personal Communication
Psychologist	€ 77,00	KPMG, 2002 (website[3])
Psychiatrist	€ 90,00	Personal communication
Mental health services		
Day treatment	€ 476,00	Oostenbrink, 2004
Outpatient treatment	€ 119,00	Personal Communication
Youth care		
Regional child care	€ 51,00	Website[4]
Social work	€ 61,68	Personal Communication
Service for the learning disabled	€ 50,00	Personal Communication
Medical day nursery	€ 182,00	Personal Communication
Special needs day nursery	€ 50,00	Personal Communication
Child care & protection board	€ 82,00	Personal Communication
Educational care		
Educational services	€ 50,00	Personal Communication
Parent		
Medical care		
General Practitioner	€ 20,20	Oostenbrink, 2004
Specialist services	€ 78,00	Oostenbrink, 2004
Company doctor	€ 85,00	Personal Communication
Physiotherapist	€ 21,50	Website[1]
Alternative medicine	€ 80,00	Health Insurance Company
Mental Health care		
Psychologist	€ 77,00	KPMG, 2002 (website[3])
Child psychologist	€ 62,50	Personal communication
Psychiatrist	€ 90,00	Personal communication
Mental health services	€ 88,00	Oostenbrink, 2004
Community care		
Social work	€ 61,68	Personal Communication
Community social work	€ 124,00	Oostenbrink, 2004

Note. Costs are estimated per unit; one unit equals one visit to a particular type of services.

Websites

[1] Physiotherapist	http://www.nza.nl and http://www.ctgzorg.nl
[2] Speech therapist	http://www.nza.nl and http://www.intramed.nl
[3] Psychologist	http://upload.lectric.nl/data.nip5/deelmarktanalyse.pdf (KPMG, 2002)
[4] Regional Child Care	http://www.jeugdzorg.nl

RESULTS

Data analysis
The Questionnaire on Work and Service Use was analyzed using χ^2 analyses and ANOVA's for the different variables. Separate analyses were conducted for the costs of lifetime service use of the child and service use over the past three months of both child and parents. For the analyses on service use of the child and damage done by the child the mothers' report was used, except for the children whose father was the primary caretaker (n = 2). Analyses were carried out in SPSS version 15.0 (2006).

Work
Results of the analyses on work are shown in Table 3. A chi-square test of independence was performed to examine the relationship between the level of aggression (the four groups) and employment status. A significant relation between group and not being able to have a job or having to work part-time due to the child's aggressive behavior was found for mothers. The largest number of mothers who were unable to work full-time due to the behavior problems of their child was found in the clinical group. In contrast, not one father reported that he was not able to work or had to work part-time due to the child's aggressive behavior.

Absenteeism at work differed significantly between the groups for both mothers and fathers; mothers and fathers of children in the clinical and borderline group were more often needed at home due to the behavior problems of their children than mothers of children in the moderate and low group. In addition, a significant difference between the groups in absenteeism at work because the parent had to visit services with her child was found for mothers. Mothers in the clinical group were more often needed for visiting services with their children than mothers of children with a low level of aggression. Parents were also asked whether they were hampered or functioned less optimal due to their child's behavior problems while working. The analysis revealed that being hampered at work or functioning less optimal was significantly related to group for both parents. Parents in the borderline group reported to be hampered at work most often, followed by parents in the clinical group.

Impairment in family functioning
Results of the analyses on family functioning are depicted in Table 3. Regarding impairments in daily functioning at home, a significant difference in the hours spent on doing household tasks (e.g., cleaning or cooking) was revealed for mothers. Mothers of children in the clinical group spent more hours on household tasks than mothers of children with lower levels of aggression. For fathers, a significant difference in time spent on doing groceries was found. Fathers in the borderline group spent more time on doing groceries than fathers in the moderate group did. With respect to the mothers who were not able to do their household tasks due to the aggressive problems of their child, mothers in the borderline group received the most paid help from others (e.g., from a daily help), significantly more than the mothers in the groups with lower levels of aggression. Fathers in the clinical group received significantly more help from family members, relatives, or neighbors than fathers of children with a low level of aggression. In addition, parents were asked to report whether they had done their household tasks, groceries, chores, and activities with their child in the past two weeks and whether they were hindered by the aggressive behavior problems of their child while carrying out these activities. For mothers, significant relations between group and

household tasks, doing groceries, doing chores, and activities with their children were found. Fewer mothers in the clinical group had done household tasks and chores, groceries were less often done by mothers in the moderate group, and activities with the children were less often carried out by mothers in the borderline group than by mothers in the other groups. No significant relations between group and carrying out any of these tasks or activities were found for fathers.

Hindrance experienced by parents due to the aggressive behavior of their child while performing these tasks was significantly related to the level of aggression of the child, for both mothers and fathers. On all of these tasks or activities, larger percentages of mothers and fathers of children in the clinical group reported to be hindered by their child's behavior problems than did mothers and fathers in the groups of children with lower levels of aggressive behavior. The smallest percentages of mothers and fathers who experienced hindrance were found in the groups of mothers and fathers of children with a low level of aggression.

Damage
Parents were also asked to report whether their child had damaged or destroyed objects in the past three months (see Table 3). A significant relation between destroying or damaging objects like toys, plates, furniture, drawings, vases, several household goods and the level of aggression was found. The analysis revealed that more children in the clinical group had damaged or destroyed objects than children in the low, moderate, and borderline group. The monetary value of the objects the child damaged or destroyed as well as the number of physical injuries caused by the child did not differ between the groups.

Service Use Child
Data reported on service use are often highly skewed, because only a small number of participants may use a specific type of service very often, whereas a substantial number of participants may have no contact with this service type at all. Therefore, in the tables presented here, the number of parents and children who actually received services is depicted, as well as the service costs for this group of parents and children. Tables 4a and 4b present utilization rates and service costs for all groups of children over the past 3 months and the first four years of life, respectively. Over the past 3 months, medical care was used by the largest number of children in all groups, but did not account for the highest costs. Although not much children used services other than medical care, the highest service costs for the group of children with a low level of aggression were caused by mental health care, and in the groups with higher levels of aggressive behavior youth care accounted for the highest costs. Due to the small number of participants who used services analyses on separate service categories were not meaningful. Therefore, the total costs (an addition of the costs of medical-, mental health-, youth-, and educational care) per group over three months were compared using one-way ANOVA. This analysis revealed a significant effect, $F (3, 177) = 4.15$, $p = .01$, and was followed by a Bonferroni post hoc test, which yielded a significant effect for the group with a low level of aggression versus the clinical group ($p = .00$). These findings indicate that the group of children who showed a clinical level of aggressive behavior was significantly more costly over the past three months than the group with a low level of aggression. In addition, a univariate ANOVA followed by a post hoc Bonferroni test was conducted on the total frequency of service use. A significant difference in the frequency of service use between the group with a low level of aggressive behavior and the group with

Table 3. Work and Family Functioning

		Mother						Father				
	N	M (SD) or %	F	χ²	p	Post Hoc	N	M (SD) or %	F	χ²	p	Post Hoc
Work												
Employed	315			7.19	.07		286			7.60	.06	
LOW	144	76.6%					173	98.9%				
MOD	37	66.1%					45	95.7%				
BOR	19	76.0%					21	91.3%				
CLIN	27	58.7%					41	100.0%				
Unable to work (full-time)	268			8.55	.04		-	-		-	ns	
LOW	1	0.6%										
MOD	3	6.4%										
BOR	1	4.5%										
CLIN	3	8.1%										
Needed at home (days)	226	9.25			.00		280		3.56		.02	.01 C
LOW	145	0.23 (0.60)				.00 C	173	0.37 (0.88)				
MOD	36	0.28 (0.78)				.00 C	45	0.62 (1.48)				
BOR	19	1.03 (1.62)					21	0.95 (1.69)				
CLIN	26	1.52 (3.04)					41	1.24 (3.38)				
Needed to visit services (days)	226		2.91		.04		-	-	-		ns	
LOW	145	0.02 (0.12)										
MOD	36	0.14 (0.68)										
BOR	19	0.16 (0.38)										
CLIN	26	0.25 (0.86)										
Functioned less optimal	226			41.69	.00		280			18.57	.00	
LOW	6	4.1%				.01 C	14	8.1%				
MOD	9	25.0%				.03 C	3	6.7%				
BOR	9	47.4%					8	38.1%				
CLIN	9	34.6%					5	12.2%				
Hours spent on:												
Household tasks	288		3.67		.01		-	-	-		ns	
LOW	172	14.92 (7.87)										
MOD	51	14.43 (6.53)										
BOR	22	16.86 (12.03)										
CLIN	43	19.37 (10.57)										
Groceries	-	-	-		ns		254		3.20		.02	.02 B
LOW							154	1.98 (1.56)				
MOD							41	1.62 (1.52)				
BOR							22	3.00 (3.21)				
CLIN							37	1.82 (1.44)				

Table 3. Work and Family Functioning (continued)

	Mother						Father					
	N	M (SD) or %	F	χ²	p	Post Hoc	N	M (SD) or %	F	χ²	p	Post Hoc
Family functioning												
Help from others (hours)												
Paid help	19		3.72		.04		-	-	-		ns	
LOW	6	2.83 (0.98)				.04 B						
MOD	6	3.00 (0.00)										
BOR	2	5.25 (2.48)										
CLIN	5	3.50 (0.71)										
Help from family	-		-		ns		246	-	3.39	-	.02	.01 C
LOW							149	0.02 (0.14)				
MOD							37	0.78 (3.51)				
BOR							21	0.24 (0.89)				
CLIN							39	2.90 (12.28)				
Help from relatives/neighbors	-		-		ns		246	-	3.48	-	.02	.02 C
LOW							149	0.02 (0.25)				
MOD							37	0.11 (0.46)				
BOR							21	-				
CLIN							39	0.23 (0.71)				
Did not do:												
Household tasks	306			10.98	.01		-	-		-	ns	
LOW	0	0.0%										
MOD	1	1.8%										
BOR	1	4.0%										
CLIN	3	6.7%										
Groceries	306			11.62	.01		-	-		-	ns	
LOW	0	0.0%										
MOD	4	7.3%										
BOR	1	4.0%										
CLIN	2	4.4%										
Chores	307			17.01	.00		-	-		-	ns	
LOW	30	16.5%										
MOD	17	30.9%										
BOR	9	36.0%										
CLIN	19	42.2%										
Child activities	308			11.36	.01		-	-		-	ns	
LOW	0	0.0%										
MOD	0	0.0%										
BOR	1	4.0%										
CLIN	0	0.0%										

Table 3. Work and Family Functioning (continued)

		Mother							Father				
	N	M (SD) or %	F	χ²	p	Post Hoc	N	M (SD) or %	F	χ²	p	Post Hoc
Was hindered in:												
Household tasks	306			78.76	.00		258			29.19	.00	
LOW	12	6.6%					3	1.9%				
MOD	16	29.1%					3	7.5%				
BOR	15	40.0%					4	0.0%				
CLIN	29	64.4%					9	24.3%				
Groceries	306			54.76	.00		261			22.17	.00	
LOW	7	3.9%					3	1.9%				
MOD	12	21.8%					3	7.1%				
BOR	8	32.0%					3	13.6%				
CLIN	20	44.4%					8	22.2%				
Chores	307			35.33	.00		263			17.24	.00	
LOW	8	4.4%					5	3.1%				
MOD	8	14.5%					5	11.9%				
BOR	5	20.0%					4	18.2%				
CLIN	16	35.6%					8	21.1%				
Child activities	308			95.39	.00		263			49.33	.00	
LOW	11	6.0%					4	2.5%				
MOD	26	47.3%					4	9.5%				
BOR	11	44.0%					6	27.3%				
CLIN	30	66.7%					15	39.5%				
Damage done by the child												
Objects destroyed	303			90.87	.00		-	-		-	-	
LOW	14	7.7%										
MOD	12	22.2%										
BOR	5	20.8%										
CLIN	32	72.7%										

Note. Post Hoc tests were Bonferroni post hoc tests; C = reported Bonferroni post hoc tests; C = reported Bonferroni p-values are groups versus the clinical group; B = C = reported Bonferroni p-values are groups versus the borderline group; ns = not significant; LOW = low levels of aggression; MOD = moderate levels of aggression; BORD = borderline levels of aggression; CLIN = clinical levels of aggression.

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a clinical level of aggression became apparent, F (3, 177) = 3.47, p = .02; Bonferroni: p = .01. The clinical group visited services significantly more often than the group of children with a low level of aggression.

Table 4b displays utilization rates and service costs over the child's whole life. Over four years, medical care was the service category that was used by the largest number of participants again, and it was also the category of service that was used most often. In contrast to the findings over the past three months, in the first four years of life medical care was for almost all groups the service category that yielded the highest costs. In the group of children with a moderate level of aggression, costs were almost equally divided over the services categories. Only in the clinical group the highest costs were clearly due to a category other than medical care, namely youth care. Again, only a small number of participants used services other than medical care. Hence, the total costs per group over four years were compared using one-way ANOVA. This analysis revealed a significant effect, F (3, 282) = 4.69, p = .00. The Bonferroni post hoc test also yielded a significant effect for the low group versus the clinical group (p = .00). These results show that over four years, the group of children with a clinical level of aggression generated more service costs than the group with a low level of aggression. Again, the total frequency of service use was analyzed and this yielded a significant difference between the group of children with a low level of aggression and the group of children with a clinical level of aggression, F (3, 284) = 4.54, p = .00; Bonferroni: p = .00. The clinical group used services more often than the group of children with low levels of aggression.

Table 4a. Child Service Use and Costs by Group (over the past 3 months)

Service	Participants using this service		Frequency of Use		Costs (Euro's)		Proportion of total costs
	N	%	Mean	SD	Mean	SD	%
LOW							
Medical care	92	48.9	2.57	2.67	95,66	103,88	29.3
Mental Health care	2	1.1	2.50	0.71	156,25	44,19	47.9
Youth care	3	1.6	1.75	0.96	74,45	22,12	22.8
Educational care	0	-	-	-	-	-	-
Total	94	47.5	2.61	2.64	99,32	105,44	-
MOD							
Medical care	33	58.9	2.70	2.76	97,54	81,90	14.8
Mental Health care	2	3.6	1.00	0.00	62,50	0,00	9.5
Youth care	6	10.7	9.00	19.11	450,67	955,19	68.2
Educational care	1	1.8	1.00	-	50,00	-	7.6
Total	35	62.5	4.17	8.57	174,22	405,46	-
BORD							
Medical care	14	56.0	4.29	5.08	163,97	223,04	36.9
Mental Health care	1	4.0	1.00	-	62,50	-	14.1
Youth care	2	8.0	2.00	1.41	167,50	164,76	37.7
Educational care	1	4.0	1.00	-	50,00	-	11.3
Total	14	56.0	4.71	5.82	195,94	271,73	-
CLIN							
Medical care	31	67.4	3.71	3.14	132,58	115,23	2.9
Mental Health care	7	15.2	2.86	1.77	364,21	526,61	7.9
Youth care	8	17.4	25.38	40.99	3252,34	4994,63	70.9
Educational care	4	8.7	16.75	28.90	837,50	1444,75	18.3
Total	34	72.3	11.91	31.63	1059,65	3151,48	-

Note. Frequency of Use and Costs (means and standard deviations) are for children who did use services; LOW = low levels of aggression; MOD = moderate levels of aggression; BORD = borderline levels of aggression; CLIN = clinical levels of aggression.

Table 4b. Child Service Use and Costs by Group (lifetime)

Service	Participants using this service		Frequency of Use		Costs (Euro's)		Proportion of total costs
	N	%	Mean	SD	Mean	SD	%
LOW							
Medical care	165	87.8	18.99	12.57	750,66	566,41	32.6
Mental Health care	16	8.5	4.94	4.49	739,31	1852,95	32.1
Youth care	1	0.5	13.00	-	663,00	-	28.8
Educational care	1	0.5	3.00	-	150,00	-	6.5
Total	167	88.4	19.33	12.95	817,37	836,35	-
MO							
Medical care	47	83.9	20.30	12.20	751,06	513,40	33.4
Mental Health care	7	12.5	8.25	7.78	715,86	741,64	31.9
Youth care	7	12.5	9.29	6.75	780,63	996,29	34.7
Educational care	0	-	-	-	-	-	-
Total	47	83.9	23.09	15.89	973,94	960,75	-
BORD							
Medical care	22	88.0	24.68	22.37	1060,28	1026,37	46.9
Mental Health care	3	12.0	6.33	5.77	395,83	360,84	17.5
Youth care	4	16.0	12.67	8.51	654,50	349,71	29.0
Educational care	1	4.0	3.00	-	150,00	-	6.6
Total	24	96.0	25.13	23.30	1136,74	1160,52	-
CLIN							
Medical care	44	95.7	22.68	15.42	914,37	734,14	27.0
Mental Health care	9	19.6	7.00	5.14	674,50	742,30	19.9
Youth care	13	28.3	12.69	11.69	1196,26	1457,30	35.3
Educational care	2	4.3	12.00	5.66	600,00	282,84	17.7
Total	44	93.6	28.57	20.19	1433,04	1419,37	-

Note. Frequency of Use and Costs (means and standard deviations) are for children who did use services; LOW = low levels of aggression; MOD = moderate levels of aggression; BORD = borderline levels of aggression; CLIN = clinical levels of aggression.

Service Use Parents

Service use of mothers and fathers in the past three months was assessed. For both mothers and fathers in all groups medical care was the service which was used by the largest number of participants. However, for both parents no significant differences between the groups in total costs and frequency of service use were found.

Total Costs: Child, parents and damage

Next, total costs of the child were computed by adding up service utilization costs of the child and both parents, and the costs of damage done by the child over the past three months. A univariate ANOVA revealed that the groups significantly differed in total costs, $F(3, 316) = 7.20$, $p = .00$. A post hoc Bonferroni test showed that the clinical group had significantly higher costs than the low and moderate group and the difference in costs between the clinical and borderline group was marginally significant, with the clinical group being more costly (LOW: $M = €$ 167,05, $SD = 272.76$, $p = .00$; MOD: $M = €$ 257,03, $SD = 409.04$, $p = .00$, BOR: $M = €$ 321,60, $SD = 424.94$, CLIN: $M = €$ 1034,83 and $SD = 2897.63$; Bonferroni post hoc test: clinical versus low and moderate group: $p = .00$).

DISCUSSION

This study into 4-year-old children with aggressive behavior tested hypotheses regarding impairments in family functioning and the costs of service use of both the child and its parents. As expected, already at 4 year of age, a difference between children with high and low levels of aggression

in both family functioning and the costs of service use became apparent, over the past 3 months as well as over the first four years of life. Parents of children with higher levels of aggression (border-line and clinical levels) showed more impairment in daily functioning than parents of children with lower levels of aggression. In addition, children who showed a high (clinical) level of aggression were found to be more costly than children with a low level of aggression, due to higher costs of services used by the child.

Although several studies have investigated family functioning and costs of children who were re-ferred to mental health services for severe antisocial behavior or a diagnosis of CD with an age range from 3 to 10 years (Knapp, Scott & Davies 1999; Romeo, Knapp & Scott, 2006), to our knowl-edge this is the first study which assessed both impact on family functioning and costs of service use in a group of 4-year-old children with different levels of aggressive behavior in a large population-based sample. Overall, the results of this study were fairly consistent with respect to impairment in daily functioning and costs of service use; differences were mainly seen between children with a high level of aggression (borderline and clinical group) and children with a low level of aggression. This complements literature demonstrating that children who do not fully meet the criteria for a disorder but who show a large number of aggressive behavior problems or subclinical levels of aggression, might experience negative and costly consequences already (Angold & Costello, 1996, 1999; Offord, 1992).

The findings on impairment in daily functioning of the parents reflect the problems which parents of children with highly aggressive behavior experience. It is shown that the impact of a preschool child with aggressive behavior on their families is large. Parents do not only carry the burden of the behavioral problems of their child and its negative consequences, but they experience additional difficulties in their own functioning at work, in their housekeeping and activities with their children. Especially mothers were hindered in their daily functioning. With respect to doing household tasks, a difference between mothers and fathers of children with aggressive behavior was found. Although fathers also reported hindrance while doing household tasks and activities with their children, fa-thers were still able to carry out these tasks and activities, unlike the mothers. This might be a con-sequence of the conventional role pattern of men and women in the Netherlands; in most Dutch families wages are mainly earned by full-time working fathers, while most part-time working moth-ers carry the responsibility for the children and housekeeping (Portegijs & Keuzenkamp, 2008).

Notwithstanding the fact that data over four years might be subject to recall bias, the findings on service use over four years correspond with the results found over three months. Regarding the costs of service use over the past three months, our results confirmed our hypotheses and were in line with other studies (Lavigne et al., 1998; Romeo, Knapp & Scott, 2006); the highest costs of service use were found for the group of children with clinical levels of aggression. Interestingly, highly aggressive children used more youth care services than children with lower levels of aggression. This might be due to limited recognition of young children's psychopathology by GPs (Zwaanswijk et al., 2005; Sayal & Taylor, 2004). As illustrated by the finding that only children who show clinical levels of aggression incurred high costs in youth care, it might be that GPs refer 4-year-old children with more severe aggressive behavior problems to youth care services first. At such a young age, GPs are probably more likely to interpret aggressive behavior in focus of parenting problems, whereas older children and adolescent will be directly referred to mental health services.

Contradictory to our hypotheses, no differences in service use and costs of both mothers and fathers were found between the groups. Although parents of children with borderline and clinical levels of aggression reported impairments in their daily functioning, they did not seek help or used services more often than parents of children with lower levels of aggression did, in contrast with the findings of Knapp, Scott & Davies (1999). This absence of increased service use of the parents of aggressive preschoolers might be due to the young age of this group of children. The aggressive behavior of the child has a direct effect on the daily functioning of the family, whereas more frequent service use of the parents might be a more indirect effect. Since a high level of aggressive behavior is often persistent and becomes more problematic over the years, the probability that parents of children with a clinical level of aggressive behavior problems will use services more frequently than parents of children with low levels of aggression increases as the child grows older.

This study has certain limitations that are important to acknowledge in interpreting the results. First, in all groups more boys than girls were included. Although no differences in gender ratio between the groups were found, the results presented here are mainly relying on data from boys. Despite the fact that the dominance of boys with respect to aggressive behavior problems is well known (Archer & Côté, 2005), by using larger groups, it should be possible to include more girls in the study and to make inferences about their service use and costs. Second, our sample consisted of highly educated parents who had children at a relatively old age. This might have introduced bias to our data on service use, because children with the most severe aggressive behavior problems often come from less educated and relatively young parents (Côté et al., 2006; Nagin & Tremblay, 2001). Third, only parental ratings of child problem behavior and service use were employed. Data on service use were collected from a single source, the primary caregiver, mostly the mother. In addition, our measure of service use was a self-report instrument for parents and data were collected retrospectively. Therefore, data might have been influenced by parental and recall biases, especially the data on service use over the first four years of life of the child. In future research, the use of additional data sources, such as administrative records of services, might help in preventing these biases. To provide a comprehensive picture of the costs of children with aggressive behavior, costs associated with loss of productivity of the parents and of service delivery should also be taken into account, e.g., travel costs, administrative costs and the child's future earnings. Fourth, the results presented here are only applicable to the Dutch health care system. In the Netherlands, not only health care but also social services and youth care are available for the whole Dutch population, and there are no financial barriers to use services. Therefore, these findings cannot be generalized to countries with other health care or social service systems. An additional limitation is that not all children in our sample went to school, which might have caused an underestimation of the costs of educational care. In the Netherlands, it is mandatory for children to attend school from age 5 onwards, but almost all children go to school at age 4. Therefore, we assume that the children who participated in this study probably attended school for only three months. Since educational costs are likely to increase as children grow older, it is important to investigate educational costs longitudinally in future research.

This study demonstrates that aggressive behavior at 4 years of age already incurs high costs and has a large impact on the family. Hence, a decrease in aggressive behavior at a young age might lead to a decrease in costs for the child, the family and wider society. If this decrease of aggressive behavior does not occur, the risk for DBD increases and costs will rise over time due to service use, delinquency, substance use and dependence, and unemployment. Recently, evidence-based interventions and prevention programs have gained attention. There is evidence that these programs

effectively reduce aggressive problem behaviors (Conduct Problems Prevention Research Group, 1999; Hutchings et al., 2007; McCart, Priester, Davies & Azen, 2006; Shaw et al., 2006). Consequently, early and accurate identification of children with high levels of aggressive behavior who might be at risk for the development of DBD, and the investment of delivering these programs with fidelity will result in large savings on the long term. Considering the fact that children with borderline and clinical levels of aggressive behavior incur the highest costs, these preventive interventions should be aimed at these high-risk groups of children to produce the most optimal financial results.

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Chapter 4

Assessing Performance of a Randomized versus
a Non-randomized Study Design
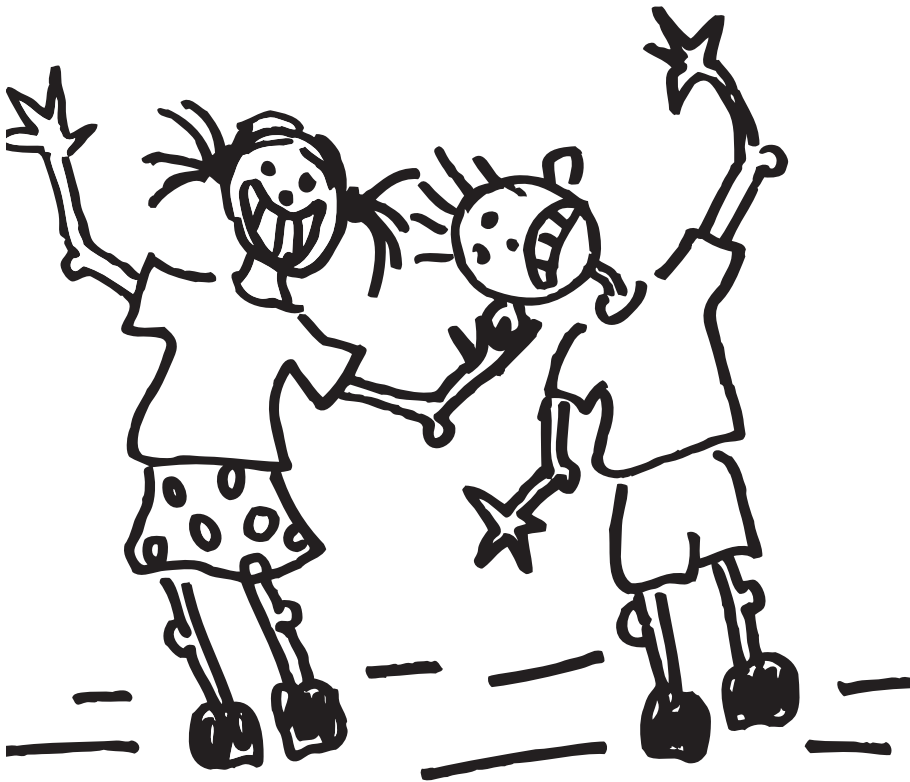
ABSTRACT

Introduction: Randomization is the most optimal design for evaluating program-effectiveness. In practice, however, conducting a randomized controlled trial is not always feasible. For a non-randomized study into the effect of a parent management training, predefined intervention and control groups of families were matched on six key characteristics. The quality of this match was then compared with the quality which is to be expected from a randomized study.

Methods: The performance of matching intervention and control families for predefined and randomized groups was evaluated by simulating new hypothetical intervention and control groups. The Mahalanobis metric was used to assess the distance between families in the intervention and the control groups and pairwise matching was performed. The global distance between these groups was used as measure of the balance of covariates in all matched pairs, with a smaller distance indicating a higher match quality.

Results: In the ideal situation, when predefined groups are actually equal to randomized groups, the expected probability of a more equal balance of characteristics in the former groups than in the latter groups is 0.50. Using the data obtained in our study, and our predefined groups, this expected probability was 0.34.

Conclusion: Even when randomized groups are more balanced than predefined groups, using the latter groups for analyses might still be acceptable when the differences in group means are small. Findings suggest that matching can be a viable alternative to randomization for situations in which randomization is not feasible due to pragmatic constraints. However, a more accurate judgment on the value of the results obtained in this study requires results from similar analyses performed in other studies for comparison.

INTRODUCTION

To evaluate the effectiveness of psychotherapeutic and pharmacotherapeutic treatment, randomized controlled trials have become a 'golden standard' (Niebuhr, 2000; Harrington, Cartwright-Hatton & Stein, 2002; Koek, Hejran & Mintz, 2005). Since participants are allocated to treatment group by chance, randomization minimizes the differences among groups and ensures approximate balance for both observable and unobservable covariates. As a consequence, there will be less confounding factors which might affect the intervention-effect and differences between groups can thus be attributed to the treatment received (Eccles, Grimshaw, Campbell & Ramsay, 2003).

However, reality sometimes complicates the process of randomization, or even makes it impossible to use this strong experimental design (Barnes, Stein & Rosenberg, 1999; Harrington, Cartwright-Hatton & Stein, 2002). As a consequence, alternatives to randomization have been developed, for example quasi-experimental and case control designs. These kinds of designs can be used when political, practical or ethical barriers to a randomized experiment are present (Eccles, Grimshaw, Campbell & Ramsay, 2003). Besides, randomization does not always diminish the need for matching to reduce the influence of confounding variables (Koek, Hejran, & Mintz, 2005), especially when the sample size is small (Hsu, 1989). Selection bias may still affect the results in properly randomized trials (Berger, 2004).

We investigated the preventive effect of a parent management training (PMT), the Incredible Years Parent Program (IY), BASIC (Webster-Stratton, 2001) and ADVANCE (Webster-Stratton, 2002), in preschool children who were at risk of the development of Disruptive Behavior Disorders (DBD). DBD is a term which covers both Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). These disorders are characterized by a persistent and pervasive pattern of antisocial behavior, including disobedience, tantrums, lying, destructiveness and stealing (APA, 2002). The IY parent training program aims to reduce the aggressive behavior of children by improving the parenting skills of their mothers and fathers. The therapeutic effect of this IY program in young children with ODD and CD has been shown in several studies (Webster-Stratton & Hammond, 1997; Taylor et al., 1998; Scott et al., 2001). Less evidence is provided for the preventive effect; this has been shown in a specific context only, i.e., Head Start (Reid, Webster-Stratton & Baydar, 2004; Webster-Stratton, 1998).

In the present study randomization of families was not feasible because of geographical and motivational reasons. The families lived scattered over 1449 km² in the province of Utrecht, The Netherlands. This province consists of 29 clearly bounded cities, towns and intermediate agricultural areas and has 1.16 million inhabitants (CBS, 2004). As motivation to participate is a recurrent problem in intervention studies, especially when families of children with conduct problems are involved (Luk, Staiger, Mathai, Wong, Birleson & Adler, 2001), we wanted to make it as easy as possible for families to participate. It has been shown (e.g., Barkley et al., 2000) that offering a preventive intervention for preschool children with disruptive behavior in a hospital results in a low attendance rate; less than half of the participants attended at least 50% of the sessions. To avoid this, we have chosen to deliver the IY program at four different sites which are within 15 km distance from the consenting families' homes and which are also easy accessible, such as community centers. Moreover, the IY program requires at least 6 parents to participate in a parent group to optimize discussion and to foster a sense of support (Webster-Stratton,

2001). Consequently, the location of the IY program had to be close to the homes of the parents and sufficient parents had to live in the same area to form a group. In addition, parents in the control group had to be blind to their condition; they were not informed of the fact that the other group received parent management training. Therefore, to prevent the two groups from running into each other, control participants had to live at a considerable distance from the participants in the intervention group, preferably in another town or city.

Because randomization was not feasible, we have chosen to use a case control design. According to the Standards of Evidence given by the Society for Prevention Research (2005), use of a case control design is permitted "as long as assignment was not by self-selection, but instead by some other factor (for instance geography)". Also according to these standards, a case control design "is credible with demonstrated pretest equivalence using adequately powered tests on multiple baselines or pretests of multiple outcomes and important covariates". This is necessary "to maximize confidence that the intervention, rather than some other alternative explanation causes reported outcomes". Thus, variables which might not be equally distributed among the two conditions and which may have an effect on the outcome need to be controlled. A matching procedure can be used to remove the "overt bias" between treatment and control groups. Bias caused by "selection on unobservables" cannot be removed by matching, except to the extent that it is correlated with the observed variables, so in the remaining article we assume that "selection is on observables". This assumption has been given different names, such as "unconfoundedness" and "ignorable treatment assignment" (for an exact mathematical description, see Deheija, 2002). Procedures other than matching can also be used to ensure that effects found are due to the intervention, such as cluster-randomization or intention-to-treat-estimation.

In our study, the participating families were matched on six characteristics which have been proven to affect either the developmental course of the child's disruptive behavior or to be a moderator of treatment effect. These characteristics are the child's gender (Lahey et al., 1999; Keenan, Loeber & Green, 1999), level of aggression (Tremblay et al.,1991; Ruma, 1996), IQ (Lahey et al., 2002; Moffitt, 1990), the parents' educational level (Nagin & Tremblay, 2001; Kazdin & Crowley, 1997), stress level (Campbell et al., 1996; Dishion & Andrews, 1995), and address density of the place of residence of the family (Rutter, 1975; Wichstrøm et al., 1996). Equally distributing these characteristics over the two groups will result in a minimization of the effect of these possible confounding variables. Results found will be mainly due to the intervention, with the exception of effects due to unobserved covariates.

In this study, we aimed to evaluate the pretest equivalence for randomization and matching by simulating the division into groups. However, in this study the required data were only available after the participants were divided into groups. We assessed the equivalence of the groups post hoc, i.e., we determined the difference in expected balance of the six characteristics, between two predefined groups, and the expected balance between two randomized groups. To calculate this expected balance between groups, we simulated a large number of predefined groups and randomized groups, using the data sample. The objective of this study was to assess the performance of pair-wise matching on our data sample by simulating predefined and randomized groups and comparing the equivalence of predefined groups with the equivalence of randomized groups.

METHODS

Participants

Out of a population-based sample of children from the province of Utrecht, the Netherlands (N = 8632), acquired by the office for screening and vaccination, 509 4-year-old children with a score at or above the 80th percentile on the Aggressive Behavior scale of the Child Behavior Check List 1½-5 (Achenbach, 2000; Dutch version by Verhulst & Van der Ende) were considered to be at risk for DBD. Families were divided in a group in which the parents would participate in the IY program, delivered in 4 different cities or towns in the province of Utrecht (the intervention group), and a group in which the parents did not receive the intervention, but only care-as-usual (the control group). We created an intervention- and a control group in 2 waves, related to the date of birth of the children. The first wave, a cohort of children born in 2000, consisted of 244 children; the second wave, a cohort of children born in 2001, consisted of 265 children.

In the first wave, 143 families who lived close to each other, at most 15 km apart, in four different areas were invited to participate in the IY program. The other 101 families who met the required criteria, but who lived in other areas, were invited to participate in the control group. Eventually, of the 143 families who were invited to participate in the IY program 34 families (23.8%) agreed. Fifty-seven families agreed to participate in the control group (56.4%). For the families from the second wave the same procedure was used. One hundred and forty families were invited to participate in the IY program, of which 40 families agreed to participate (28.6%). One hundred and twenty-five families were invited to be in the control group, of which 63 families agreed to participate (50.4%). Between pre- and post assessment 10 control families were lost to attrition due to different reasons; participation was a too heavy burden for the family, personal circumstances such as divorce, removal or medical conditions, or families were unreachable. As a result, one-hundred and eighty-four families participated in this study; 74 families participated in the intervention group and 110 families in the control group. All mothers, except two, and 169 fathers participated. All children were about 4 years old at pre-assessment, ranging from 42 to 57 months (*M* = 50.9, *SD* = 2.8). Descriptives of the child- and parent characteristics which were used for matching are depicted in table 1 and 2. In table 2 the distribution of several characteristics is also presented.

Table 1. Descriptive characteristics of the intervention and control group: Frequencies

	Value	IG (%)	CG (%)	Overall (%)
Characteristic				
Sex	Boy	52 (70.3)	61 (55.5)	113 (61.4)
	Girl	22 (29.7)	49 (44.5)	71 (38.6)
Education	Primary	0 (0.0)	2 (1.8)	2 (1.1)
	Secondary	3 (4.1)	4 (3.6)	7 (3.8)
	Intermediate vocational	22 (29.7)	37 (33.6)	59 (32.1)
	Higher vocational	29 (39.2)	37 (33.6)	66 (35.9)
	University	20 (27.0)	30 (27.3)	50 (27.2)
Address density	< 500 (rural)	1 (1.4)	1 (0.9)	2 (1.1)
	500-1000 (slightly rural)	13 (17.6)	34 (30.9)	47 (25.5)
	1000-1500 (moderately urban)	15 (20.3)	43 (39.1)	58 (31.5)
	1500-2500 (fairly urban)	33 (44.6)	20 (18.2)	53 (28.8)
	> 2500 (highly urban)	12 (16.2)	12 (10.9)	24 (13.0)

Note. Address density is defined as the mean number of addresses within a radius of one kilometer; IG = Intervention Group; CG = Control Group

Table 2. Descriptive characteristics of the intervention and control group: Quantiles

		Aggression			IQ			Stress level		
		IG	CG	Overall	IG	CG	Overall	IG	CG	Overall
Minimum value		16	16	16	76	81	76	36	34	34
Quantile	0.1	17.0	17.0	17.0	90.6	94.0	92.0	45.3	45.9	45.3
	0.2	18.4	18.0	18.0	100.0	99.2	100.0	54.4.	47.6	50.4
	0.3	20.0	19.0	19.0	103.0	103.0	102.3	58.3	55.0	56.3
	0.4	21.0	20.0	20.0	105.0	106.0	105.0	61.0	60.4	61.0
	0.5	22.0	21.0	21.0	107.0	110.0	108.0	67.0	68.5	68.0
	0.6	22.0	22.0	22.0	110.0	113.0	111.0	72.8	74.0	74.0
	0.7	23.9	23.0	23.0	111.0	118.0	114.0	76.9	80.0	79.9
	0.8	25.0	25.0	25.0	116.0	120.2	119.0	87.0	83.0	85.0
	0.9	28.0	28.0	28.0	119.0	121.0	121.0	92.5	94.0	94.0
Maximum value		36	34	36	127	132	132	121	131	131
Average value		22.18	21.73	21.91	106.45	108.85	107.88	70.15	69.02	69.47
Standard deviation		4.54	4.32	4.40	10.88	11.13	11.06	19.39	20.22	19.85

Note. IG = Intervention Group; CG = Control Group

Procedure

Written informed consent was obtained from the participating families. A set of questionnaires was mailed to the parents. IQ of the children was assessed at their homes. Children received a small gift for their participation and parents received a monetary reward. The participating families were blind to their condition, intervention group or control group (no intervention, only care-as-usual). All families will be informed of the study design retrospectively. The study was approved by the Medical Ethical Review Committee of the Utrecht University Medical Centre.

Measures

CBCL 1½-5

The level of aggression at the beginning of the parent management training was measured by the Child Behavior CheckList 1½ – 5 Aggressive Behavior scale (Achenbach, 2000; Dutch version by Verhulst & Van der Ende). This scale contains items like "hits others", "does not feel guilty" and "often has temper tantrums". Parents circle the answer which fits the behavior of their child; "never", "sometimes" or "always". The borderline range (93rd percentile) contains raw scores from 21 to 23 and scores of 24 and higher are in the clinical range (97th percentile).

WPPSI-R

The IQ of the child was assessed with the Wechsler Preschool and Primary Scales of Intelligence (WPPSI-R) (Wechsler, 1997; Dutch-Flemish version by Vander Steene & Bos). The subtests Picture Completion, Vocabulary, Block Design and Similarities were used to estimate full scale IQ (correlation of subtests with full scale IQ is .92), following the guidelines of Sattler (1992).

Educational level

In this study educational level was used as an indicator of socio-economic status. The highest education of both parents was used to measure the educational level of the parents. This level was measured on a five-point-scale ranging from primary education to university education.

PSI

Stress was assessed using the Dutch version of the Parental Stress Index (Abidin, 1990; De Brock, Vermulst, Gerris & Abidin, 1992). Subscales of Role Restriction, Social Isolation, Marital Relation and Health were used to determine the level of stress of the parents. Answers were rated on a six-point Likert scale, ranging from "totally disagree" to "totally agree". For most families, the mothers' stress score was used, because she was the primary caretaker of the child. If the score of the mother was not available, the fathers' stress score was used.

Address density

Address density was used as a measure of urbanization, and it is defined as the mean number of addresses within a radius of one kilometer (CBS, 2004). A five-point scale was used, ranging from a very rural area (1; less than 500 addresses in the radius of 1 km) to a very urban area (5; 2500 addresses or more).

Description of the matching procedure

For each family that participated we have the set of six characteristics {aggression, IQ, stress, education, address density, sex}. Let I denote the list of families in the intervention group, with l_{ik} representing the characteristics of family i ($1 \leq i \leq 74, 1 \leq k \leq 6$) and C the list of families in the control group, with C_{jk} representing the characteristics of family j ($1 \leq j \leq 110, 1 \leq k \leq 6$). In general, a matching procedure requires two implementation choices: the distance measure and the type of algorithm (for an example of a comprehensive comparison of distance measures and algorithms see Augurzky & Kluve, 2004). To avoid the "curse of dimensionality", the problem caused by the exponential increase in volume associated with adding dimensions to a mathematical space, we do not use the differences in values for the six characteristics separately. Instead, we map differences in values for the six characteristics into a single scalar measure of difference. For the distance measure we choose the least complex measure that is able to take into account any correlations within the dataset, which is the Mahalanobis metric (see e.g., Rubin, 1980), and used this metric on the covariate values. As an alternative, we could have used this metric on propensity scores (for example Rosenbaum, 1985). However, simulation studies have shown that Mahalanobis matching is relatively robust, and also performs well in small sample sizes ($n \leq 500$) when propensity score matching does not (Zhao, 2004). The choice for Mahalanobis matching was motivated by our small sample size and relatively few covariates. Propensity score matching seems to outperform Mahalanobis matching when the overt bias and the number of covariates are large (Gu & Rosenbaum, 1993).

Since we want to compare the performance of randomization with person to person based matching on a large number of simulated datasets, using an optimal pair-matching algorithm was not computationally feasible. While a simple greedy pair-matching algorithm is much faster than an optimal matching algorithm, generally it does not find a match for all intervention families. Accordingly, some families are dropped towards the end of the matching procedure and therefore it produces different results on different runs (Augurzky & Kluve, 2004). As we want to take into account all intervention families for the assessment of the treatment effect, we choose to develop a modified version of the greedy pair-matching algorithm. While our algorithm, consisting of the steps below, is also not optimal and slower than greedy pair matching, it does perform better (leading to smaller distances). Our algorithm returns a matched control family for all intervention families and results are exactly

similar on different runs. The only input parameter for the algorithm is Z, the number of best matches to store for any intervention family. For matching we used the nearest-neighbor algorithm on the Mahalanobis distance between families. The overall (global) distance between two groups was calculated as the sum of the squared differences between each matched pair of families. Finally, we compared the global distance between the two predefined groups with the global distance between the two randomized groups.

Steps of the matching algorithm

Variable definitions

(intervention families are indexed with i (or k), control families with j)

N	The total number of intervention families to be matched
M	The total number of control families available for matching
I_i	Intervention family with ID i ($1 \le i \le N$)
Z	The number of control families closest to an intervention family that should be considered as possible candidates for matching
M_{ij}	The Z control families ($1 \le j \le Z$) that are possible candidates for matching with intervention family i
V_i	List of flags (value 0 or 1) that indicate whether intervention family i is not yet matched (value 1) or already matched (value 0)
A_j	List of flags (value 0 or 1) that indicate whether control family j is still available for matching (value 1) or not (value 0)
C_{1i}	The ID of the control family that is closest to intervention family i and is still available for matching
C_{2i}	The ID of the control family that is the second closest to intervention family i and is still available for matching
D_{1i}	The distance between intervention family i and its closest, still available control family C_{1i}
D_{2j}	The distance between intervention family i and its second closest, still available control family C_{2i}
B_i	The benefit of matching intervention family i with its closest, still available match, i.e. control family C_{1i}
H	The global (overall) matching distance

Algorithm steps

1. Set N to the total number of intervention families, and set M to the total number of control families. Determine for each intervention family I_i the list M_{ij}, consisting of Z control families which have the smallest distance to I_i. Order these control families such that Mij has the smallest distance to Ii for j=1, and Mij has the largest distance to I_i for j=Z, i.e. with increasing distance as j increases. Mark all intervention and control families as "not yet matched" by setting V_i = 1 for $1 \le i \le N$ and A_j = 1 for $1 \le j \le M$. Set the global matching distance H to zero.

2. Determine for all unmatched intervention families Ii (i.e. for all i with Vi = 1) the nearest, still available, control family C1i (i.e. Mij with the smallest value of j for which Aj = 1). Set D1i to the distance between Ii and its closest, still available control family C_{1i}, i.e. $D_{1i} = DMahalanobis(I_i, C_{1i})$.

3. Determine for all unmatched intervention families Ii (i.e. for all i with Vi = 1) the second nearest, still available, control family C_{2i} (i.e. Mij with the second smallest value

of j for which $A_j = 1$). Set D_{2i} to the distance between I_i and its second closest, still available control family C_{2i}, i.e. $D_{2i} = D_{Mahalanobis}(I_i, C_{2i})$.

4. Determine for all unmatched intervention families Ii the benefit B_i of matching it with, its closest, still available, control family C_{1i}. Calculate B_{ij} as

$$B_i = D_{1i}^2 - \sum_{k=1}^{N} t_k (D_{1k}^2 - D_{2k}^2) \text{ with } t_k = \begin{cases} 0, & \text{if } V_k = 0 \text{ or } C_{1i} \neq C_{1k} \text{ or } k = i \\ 1, & \text{otherwise} \end{cases}.$$

with. The benefit of matching intervention family Ii with control family C_{1i} is thus expressed in terms of the resulting distance D_{1i} and the deterioration of the matching distance for other intervention families ($t_k \neq 0$ only when $k \neq i$) that also could have been matched with C_{1i}. Only the deterioration for other intervention families that have not yet been matched (tk $\neq 0$ only when Vk $\neq 0$) and have the same control family as closest, still available match (tk $\neq 0$ only when $C_{1i} = C_{1k}$) is considered.

5. Determine which of the unmatched intervention families to match next, i.e. select the intervention family with ID z, I_z, for which $B_z = Max(B_i)$, for $1 \leq i \leq N$ and $V_i = 1$.

6. Increase the global distance, $H = H + D_{I_z}^2$. Mark the matched intervention family I_z and the matched control family C_{I_z} as unavailable for further matching by setting $V_z = 0$ and $Ac_{I_z} = 0$.

7. If $\sum_{i=1}^{i=N} V_i > 0$ then not all intervention families have been matched yet, continue matching families by returning to step 2.

Description of the simulation procedure

To compute a robust estimate of the difference in the quality of the match for the predefined groups and the randomized groups, we performed a large number of simulations each consisting of the following steps. The input parameter X for the simulation is just the number of comparisons to simulate.

Steps of the simulation procedure

1. Set the current simulation number V, to 1.
2. Given the empirical distributions of the characteristics in the predefined intervention and control groups (Table 1 and 2), construct a new intervention group IP and a new control group CP, with characteristics drawn at random and independently from the individual distributions.
3. Given the empirical distributions of the characteristics in the overall group (i.e. intervention and control group combined, Table 1 and 2), construct a new intervention group IR and a new control group CR, with characteristics drawn at random and independently from the pooled distributions.
4. Determine the matching distance MDP between IP and CP, and the matching distance MDr between IR and CR, by running the matching algorithm twice and setting MDP and MDr equal to global distance, H, obtained when matching the corresponding groups.
5. Calculate DiffV = MDP – MDR, the difference in matching distance, and
   a. RelDiffV = DiffV / MDR the corresponding relative difference. Set $IMP_V = \begin{cases} 0, & \text{if } Diff_V \geq 0 \\ 1, & \text{if } Diff_V < 0 \end{cases}$,the indicator denoting whether or not the match using predefined groups was more balanced than the match using the randomized groups.

6. Increase the current simulation number V by one and continue with step 2 if V ≤ X.

Note that step two and three of the simulation procedure are executed for every run, in total X times, implying that the total number of datasets sampled from the empirical distributions equals 4*X. For large numbers of X we effectively sample the differences in characteristics as observed in the predefined intervention and control group by comparing two random samples based on the marginal distributions to two random samples based on the pooled distribution. Since the six characteristics in our dataset are nearly uncorrelated, Kendall's τ was highest for aggression and stress (0.25, p <.01) and the correlations between the other variables were all below 0.2 and not significant, we draw independent values from the distribution of each characteristic in steps two and three. However, when characteristics are correlated this correlation should be taken into account when simulating the datasets. In this case a multivariate distribution should be used in steps two and three to ensure that the correlation in the simulated datasets is similar to the correlation in the original dataset.

For the assessment of the balance of covariates between predefined and randomized groups, we look at the distributions of $Diff_V$ (the difference in matching distance) and $RelDiff_V$ (the relative difference in matching distance). To determine which distance between two groups is acceptable and which distance is not, we translate these distances to differences that are interpretable in the context of our dataset. In practice, the similarity between groups is often assessed by comparing the mean values of characteristics within groups. For example, the difference in mean value of age between the groups is then used to decide whether or not the similarity (with respect to age) of the two groups is acceptable. Therefore, we also report the differences in mean group characteristics that correspond to our results on relative differences in matching distance. Both the matching algorithm and the simulation procedure were implemented in Microsoft Excel (v9.0) using VBA.

RESULTS

We assessed the difference in balance for both the predefined and the randomized groups using the following settings: 20000 simulations, with 75 best matches to store for every intervention family. In all simulations, all 74 intervention families were matched with exactly one control family. The distribution of the difference in matching distance ($Diff_V$) over the 20000 simulations is shown in figure 1. Note that the differences in distance (depicted on the horizontal axis) are determined completely by the matching metric and the manner in which the global distance is computed from the difference per matched pair of families. The use of another metric or computational method for the global distance may demonstrate different results. Figure 1 shows that the minimum distance between randomized groups is expected to be smaller than the minimum distance between predefined groups. Although the difference is expected to be positive, it is not expected to be very large because the bulk of the distribution is centered near zero. The probability that the randomized groups are more balanced than the predefined groups is visualized in figure 2. The relative difference between the minimum distance found for two predefined groups and the minimum distance found for two randomized groups is shown on the horizontal axis. A relative difference close to −1 indicates that the distance for two predefined groups was only a fraction of the distance for two randomized groups (and close to zero), i.e. a much better balance was found for the

predefined groups. A relative difference close to 0 indicates no relevant differences while a relative difference much larger than 0 indicates that a much better balance was found for the randomized groups than for the predefined groups.

Figures 1 and 2 show that matching using predefined groups results in a smaller matching distance than matching using two randomized groups (solid line) with probability 0.34, given the distribution of characteristics in our groups. When the predefined groups are defined to be exactly similar (i.e. the distinction between predefined and randomized groups is removed) and the complete simulation process is repeated, this probability is maximized, at 0.50 (dotted line). Our predefined groups cannot perform better than indicated by the dotted line, which we would always accept, i.e. with probability 1. Therefore, after matching our predefined groups, we might argue that we should accept these groups with a probability of 0.34/0.50 = 0.68. Should we allow, for instance, a distance between our predefined groups that is at most twice the distance between randomized groups (i.e. a relative difference of 1), the probability of obtaining an acceptable match increases to 0.86 (i.e. 0.68, with our predefined groups, divided by 0.79, with exactly similar predefined groups).
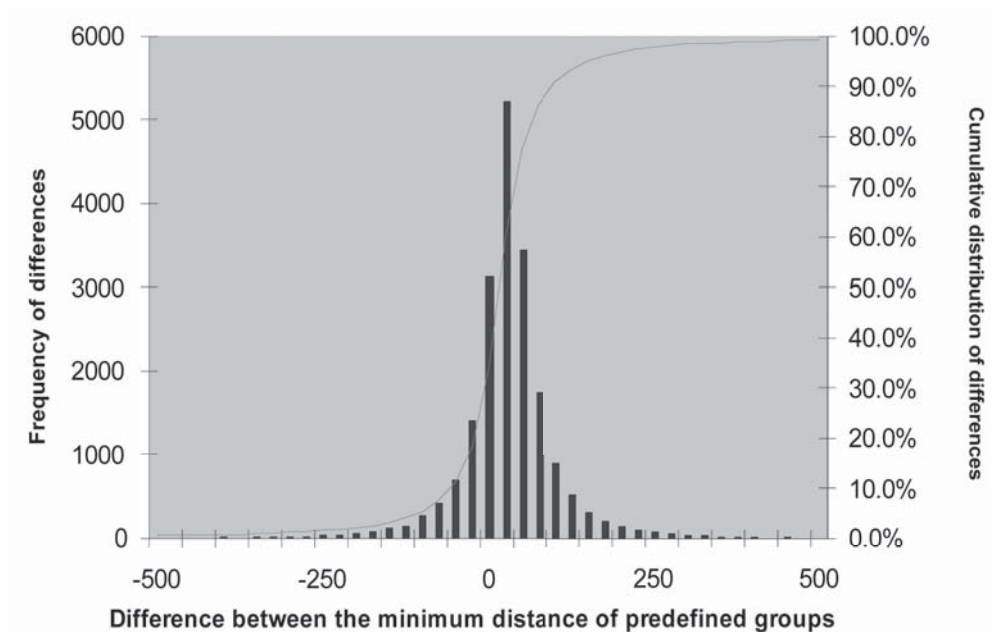

Figure 1. Frequency distribution of the size of the differences in matching distance, between the predefined groups and between the randomized groups (left side). The cumulative distribution of the differences is also shown (right side).
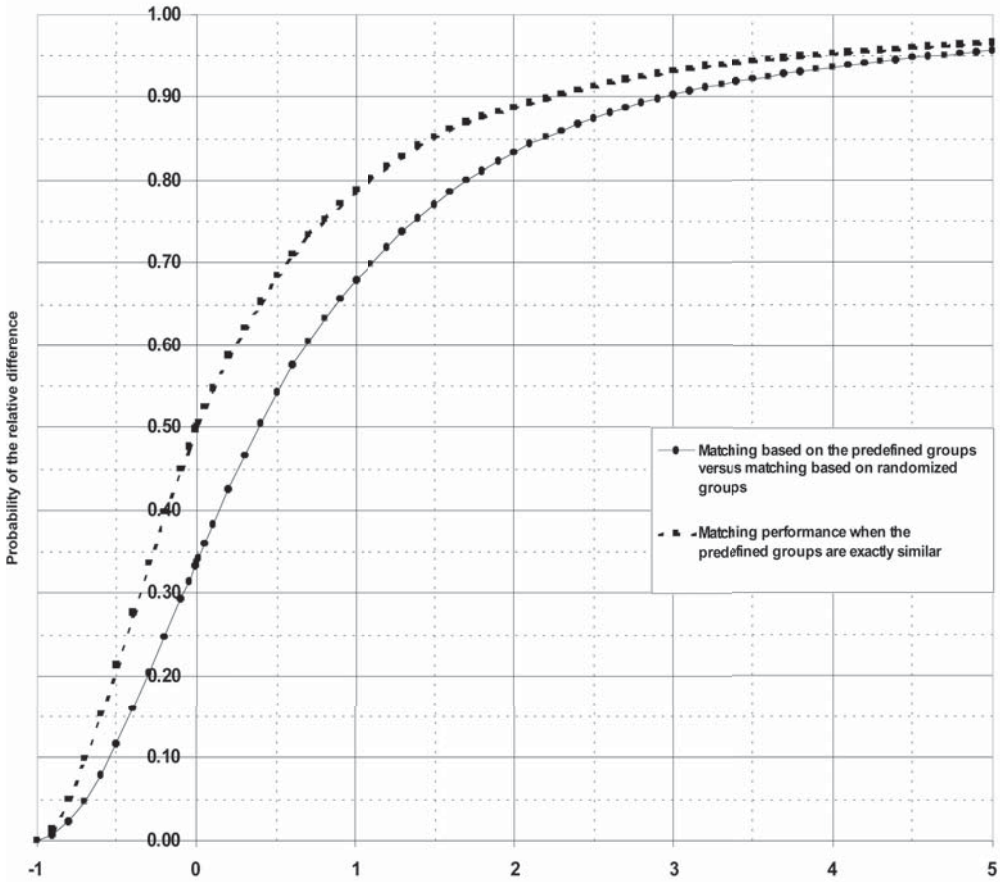
Figure 2. The probability of obtaining a relative difference in matching distance, i.e. the matching distance between the predefined groups minus the matching distance between the randomized groups, divided by the matching distance between the randomized groups (solid line). The same probability is visualized for the hypothetical situation in which the predefined groups are exactly similar, and therefore also similar to the randomized groups (dotted line).

To investigate what relative difference in matching distance may be considered acceptable in practice, we have depicted the difference in group means for child IQ, aggression and parental stress, as a function of the relative difference in matching distance in Figure 3.

These differences in group means are simultaneously expected values, given the relative difference. As expected, the overall difference in group means is smaller for the randomized groups than for our predefined groups. This is most notably the case for IQ, for which the differences in mean values between the predefined groups, expressed as fraction of the SD, are largest. The difference in mean values between the predefined groups for stress (which is distributed similarly in both predefined groups), however, may be smaller than that difference for the randomized groups. This is the case when the matching distance between the predefined groups is less than half the matching distance between the randomized groups. Note that, generally, there does not exist a strong relation between the difference in group means and the relative difference in matching distance. This implies that the difference in
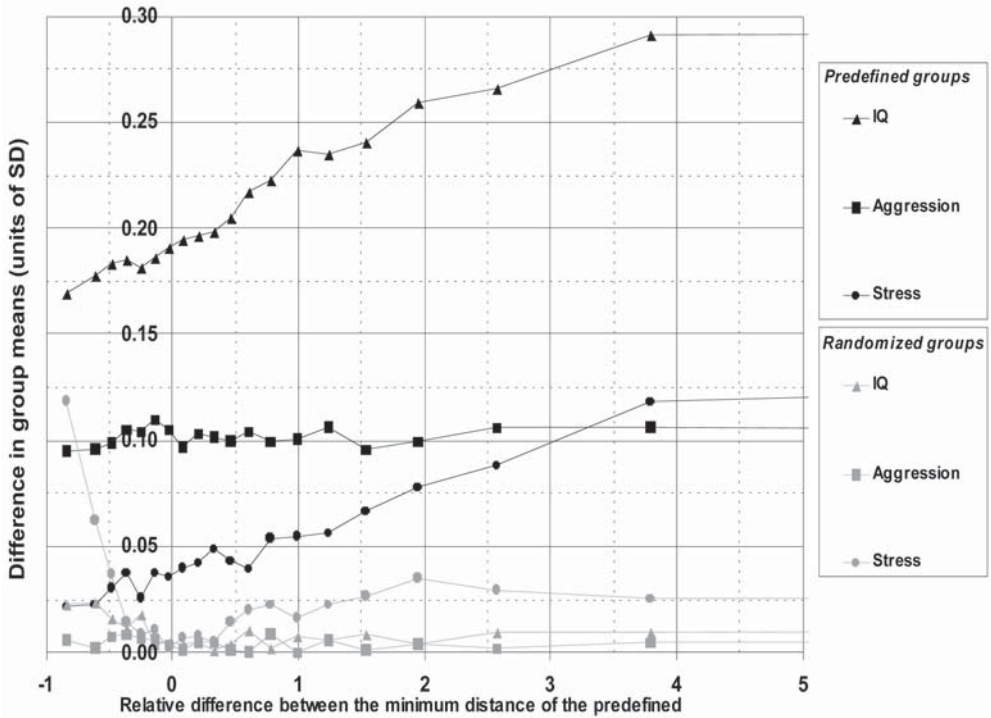
Figure 3. The difference in group means, for child IQ, child aggression and parental stress, between the two predefined groups and between the two randomized groups, expressed as a fraction of the corresponding standard deviation and as function of the relative difference in matching distance. The corresponding standard deviations are σ = 11.1 (IQ), σ = 4.4 (aggression), and σ =19.8 (stress).

group means do not, give a good indication of the actual balance of characteristics between matched pairs and vice versa. Consider for instance the difference in mean aggression in Figure 3. Whether the randomized groups outperform the predefined groups (relative difference > 0) or not (relative difference < 0), the difference in mean aggression roughly equals 0.01σ (randomized groups) and 0.11σ (predefined groups). When Figure 3 and Figure 2 are combined it can be calculated that, when simultaneous differences of for example 0.27σ in IQ (3.0 pts), 0.10σ in aggression (0.4 pts) and 0.07σ in stress (1.4 pts) are deemed acceptable, the relative difference may be as large as 2 (Figure 3). Therefore the probability of obtaining an acceptable match increases to 0.83/0.89 = 0.93 (Figure 2).

DISCUSSION

The objective of this study was to assess the performance of pairwise matching on our data sample by simulating predefined and randomized groups and comparing the equivalence of predefined groups with the equivalence of randomized groups. Findings revealed that matching using our predefined groups leads to a more equally balanced distribution of the six key characteristics than randomization in 34% of the simulated trials (with 50% of the trials as theoretical maximum). In the remaining 66% of the trials, the absolute differences in group means for the characteristics in the predefined groups may still be small, although these dif-

ferences are larger than in the randomized groups.

This study does not pretend to provide an alternative for randomization in general. It also does not argue against the use of randomization whenever possible. A huge advantage of randomization is that it usually removes selection bias in addition to removing overt bias, while matching cannot be used to deal with bias due to unobserved variables. If it is not feasible to conduct a randomized controlled trial due to pragmatic limitations however, a case control design might then be a second best option. Although there are many matching techniques (such as post hoc propensity score matching used to minimize bias) the performance of matching non-randomized groups is rarely compared to the performance of matching randomized groups. Furthermore, in most intervention studies little attention is paid to the multivariate assessment of group equivalence; only univariate equivalence is assessed by comparing group means. Due to this lack of interest, no standardized methods have been developed to assess the equivalence of the distribution of sample characteristics over the intervention and control group. We used a self-chosen algorithm to investigate the equivalence of our predefined groups. These matched predefined groups were compared with matched randomized groups. Equivalence is often assumed for randomized groups but matching for confounding variables sometimes remains necessary (Koek, Hejran, & Mintz, 2005).

Note that when the final matching of our predefined groups is performed, this unique match is determined only once and it will be either more or less balanced than when randomized groups would have been created. Our equivalence measure is a global performance indicator of balance that does not inform us whether or not our predefined groups are more balanced than randomized groups, after the final matching process.

Both the distribution of variables within and of the predefined groups and the number of available control families per intervention family directly influence the outcome of our comparison. This implicates that the results of this simulation study are limited specifically to this sample. This is for example, when more control families are available the difference in equivalence between groups will be smaller and vice versa. Thus, this method does not guarantee an optimal balance between control- and intervention groups; a distribution of variables based on another sample might lead to a different probability of equally balanced groups. However, the method described can be applied to assess the performance of any non-randomized design and is not restricted to our research topic.

Another limitation of this study is that the choice of the method used to calculate distances, on pair level and on group level, was rather arbitrary. Other matching techniques, such as propensity score matching, can also be applied and might lead to slightly different results. In addition, we only allowed the matching of exactly one control family with each intervention family. In some situations, matching one intervention family with multiple control families (either a fixed or variable number) might improve bias reduction and lead to different results. If the performance of non-randomized designs is assessed more often in a quantative fashion as described here and the results of these analyses become available, understanding the consequences of using non-randomized study designs will be enhanced. For this reason, other non-randomized trials should also use this kind of quantative methods to show that matching is a viable alternative to randomization. To improve the quality and applicability of non-randomized studies, it is required that matching- (and simulation) procedures are carried out

in an accurate and meticulous manner and that the results from these efforts are reported. Furthermore, the results presented here will gain usability and clarity when other studies report the result of comparing matching performance on predefined groups with matching performance on randomized groups using their own data sample. The quality of our design will become more apparent, and our probability of 0.34 of outperforming randomization will gain meaning only through comparison with results of other, similar analyses.

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Chapter 5

The evaluation of a preventive intervention for 4-year-old children at risk for Disruptive Behavior Disorders: Effects on parenting practices and child behavior

ABSTRACT

Background: Aggressive behavior often originates in early childhood and results in negative developmental outcomes. Therefore, prevention of conduct problems or Disruptive Behavior Disorders (DBD) is critically important. Parent training has been proven to be effective in reducing conduct problems in treatment studies. However, the evidence for the preventive effect of parent training is less consistent. The current study aimed to evaluate the preventive effectiveness of the Incredible Years Parent Program.

Methods: From a population-based sample, parents of 144 preschool children who were considered to be at risk for DBD due to a high level of aggressive behavior (scores at or above the 80th percentile on the Aggressive Behavior scale of the CBCL 1½ -5) were divided into an intervention group (N = 72) and a matched control group (N = 72). Parenting practices and child behavior were assessed by observations and parent- and teacher-questionnaires at pre- and post-intervention, and at one-year follow up.

Results: Our results revealed significant improvements in both observed and parent-rated parenting practices, which were maintained over time. In addition, observed child behavior also showed sustained intervention-effects, but parent- and teacher-rated child behavior did not. At one-year-follow up, the occurrence of DBD diagnoses did not differ between the groups. Evidence for mediation of child behavior by parenting practices could not be demonstrated. The intervention effect was moderated by parental stress, the child's IQ and level of inhibitory control. The intervention was most beneficial to children with low IQ, poor inhibitory control and parents with high levels of stress.

Conclusion: This population-based study highlights the potential of the IY parent program as a preventive intervention for preschool children at risk for DBD.

INTRODUCTION

Aggressive behavior is very common in early childhood. The level of aggressive behavior in children peaks around 2 or 3 years of age and then gradually declines (Alink et al., 2006; Tremblay et al., 2004). When this decline fails to occur, there is a reason for concern. Several studies have investigated the developmental trajectories of aggression (Broidy et al., 2003; Campbell, Spieker, Burchinal, Poe & NCHID Early Child Care Research Network, 2006; Côté, Vaillancourt, LeBlanc, Nagin & Tremblay, 2006; Nagin & Tremblay, 1999; Schaeffer et al., 2006; Shaw, Lacourse & Nagin, 2005). All these studies report on the existence of a trajectory of chronic high levels of aggression, among other trajectories, and regarded this trajectory as most problematic. High levels of aggressive behavior have been found to be relatively stable and highly persistent over time (Broidy et al., 2003; Farrington, 1994; Nagin & Tremblay, 1999; Schaeffer, Petras, Ialongo, Poduska & Kellam, 2003) and can be seen as risk factors for the development of a chronic pattern of disruptive behavior or a Disruptive Behavior Disorder (DBD; APA, 2000). With prevalence rates of 2.4% for girls and 6.0% for boys, DBD, a term which covers both Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) are among the most prevalent child psychiatric disorders (Messer, Goodman, Rowe, Meltzer & Maughan, 2006). In addition to the negative developmental consequences of disruptive behavior for the individual, such as poor school-, interpersonal-, and occupational adjustment, substance abuse, delinquency and other psychiatric disorders, such as Depression and Antisocial Personality Disorder (Briggs-Gowan, Carter, Bosson-Heenan, Guyer & Horwitz, 2006; Kim-Cohen et al., 2003; Lavigne et al., 2001; Maughan, Rowe, Messer, Goodman & Meltzer, 2004; Maughan & Rutter, 2001), these disorders also incur high costs to society (Scott, Knapp, Henderson & Maughan, 2001).

Several interacting individual and environmental factors are associated with chronic high levels of aggression and the emergence and persistence of DBD. *Individual factors* are e.g., male gender (Côté et al., 2006; Farrington, 2005), low IQ (Farrington, 2005; Lahey, 2002), deficits in inhibitory control (Hughes, White, Sharpen & Dunn, 2000; Raaijmakers et al., in press, Chapter 2), a low level of autonomic arousal (Crowell et al., 2006; Lorber, 2004), and the initial severity of the aggressive behavior of the child (Loeber & Farrington, 2000; Ruma, Burke & Thompson, 1996; Tremblay et al., 1991). Parental stress and psychopathology (Campbell, Pierce, Moore, Marakovitz & Newby, 1996; Morgan, Robinson & Aldridge, 2002; Shaw et al., 2005), low SES (income and parental education; Côté et al., 2006; Nagin & Tremblay, 2001), young motherhood (Côté, Vaillancourt, Barker, Nagin & Tremblay, 2007; Tremblay et al., 2004), family dysfunction (Tremblay et al., 2004; Loeber & Farrington, 2000) and coercive or ineffective parenting (Côté et al., 2006, 2007; Patterson, 1982; Webster-Stratton & Taylor, 2001) are examples of *environmental factors* which play a part in the development and persistence of aggressive behavior or DBD. With respect to these environmental factors, parenting practices are most important in the preschool period (e.g., Patterson, 2002). Since ineffective parenting, e.g., physical punishment, inconsistent discipline and poor responsiveness to the child (Farrington, 2005; Snyder, Cramer, Afrank & Patterson, 2005; Webster-Stratton & Taylor, 2001), is associated with the development and persistence of aggressive behavior, whereas effective parenting serves as a protective factor (Frick, Christian & Wootton, 1999; Tremblay et al., 2004), addressing parenting practices is considered to be an obvious starting point for treatment and preventive interventions.

Yet, a preventive approach entails several difficulties. Indicated prevention is targeted at children who are at high risk because of a predisposition for a disorder, e.g., biological markers, or at children who already show some symptoms of a disorder (Mrazek & Haggerty, 1994). Although adequate screening for children at risk or identifying those children who are most likely to benefit from an intervention is required in indicated prevention, the small effect sizes yielded by these prevention programs are still probably due to the impact of children who are inaccurately identified as being at risk (Bennett, Lipman, Racine & Offord, 1998; Offord & Bennett, 2002). The detrimental impact of these 'false positives' highlights the importance of accurate screening for effective preventive interventions (Hill, Lochman, Coie, Greenberg, & Conduct Problems Prevention Research Group, 2004). As a consequence, effect sizes reported in treatment studies are almost always larger than intervention effects found in prevention research (Patterson, DeGarmo, Forgatch, 2004).

From treatment studies, parent management training has emerged as the most effective intervention for preschool and school-aged children with disruptive behavior problems (Kazdin, 1997; McCart, Priester, Davies & Azen, 2006; Scott, 2002). Moreover, parent management training also appears as the single most effective component when compared to child- or teacher-training, or a combination of these components (Webster-Stratton, Reid & Hammond, 2004). The parent management training from the Incredible Years Videotape Modeling Program (IY; Webster-Stratton, 2001; Webster-Stratton & Hancock, 1998), aimed at the improvement of parenting skills in order to reduce the aggressive behavior of the child, is one of the most effective evidence-based treatment interventions for parents of children with aggressive behavior problems (Gardner et al., 2006; Scott, Spender, Doolan, Jacobs & Aspland, 2001; Webster-Stratton, 1990; Webster-Stratton et al., 2004). Results of these studies show increased use of positive parenting skills and a decrease in harsh and inconsistent parenting, resulting in less aggressive behavior of the children.

However, evidence for the effectiveness of the IY parent program as a preventive intervention is less clear. In a review of successful and unsuccessful prevention trials, the IY parent program as studied by Webster-Stratton (1998) is listed with the preventive interventions which did not reduce conduct problems in preschoolers (LeMarquand, Tremblay & Vitaro, 2001). The program was considered to be only partly successful, because a modest reduction in observed conduct problems was found at one-year follow-up, but mothers or teachers did not report this reduction. These results are labeled as 'promising' for a preventive intervention (LeMarquand, Tremblay & Vitaro, 2001). In contrast, the IY parent program has subsequently been evaluated as an effective prevention program in disadvantaged and high risk populations. In a context of Head Start, Webster-Stratton, Reid & Hammond (2001) evaluated the preventive effectiveness of the IY parent- and teacher training, and reported fewer conduct problems at home and at school for the intervention group of 4-year-old children when compared to the control group. Children who were most at risk also showed clinically significant reductions in conduct problems and effects for the total group as well as the high risk group were maintained to one-year follow-up. Similarly, Hutchings et al (2007) evaluated the preventive effectiveness of the IY parent program for children aged 3 to 5 years in Sure Start areas in Wales (UK) and found significant reductions in disruptive child behavior as reported by the parents at follow-up.

The studies mentioned above evaluated the preventive effect of IY in the setting of a larger

program for disadvantaged families (Head Start or Sure Start). Brotman et al (2008) conducted a study into the preventive effects of the IY program for parents and children for a group of children who were considered to be at risk because of an adjudicated sibling. Positive intervention effects were found on children's observed physical aggression, but not on parent-rated aggression of the children. In addition, none of these preventive studies has investigated mediational processes. Furthermore, the IY parent program consists of two components; a BASIC component that addresses parent-child interaction and an additional ADVANCE component aimed at enhancing communication skills, social support, and problem solving skills. Most studies into the IY parent program have evaluated the effectiveness of the BASIC component, but not of the ADVANCE component.

Parent programs might not be equally beneficial to all children. The effectiveness of a program differs with different levels of child- and parent characteristics. Few studies into moderators of intervention effects have been conducted. However, several moderators of intervention effect have been proposed from theory, and factors associated with the emergence and persistence of aggressive behavior have been investigated as putative moderators. Beauchaine, Webster-Stratton and Reid (2005) identified marital adjustment, maternal depression, paternal substance abuse and child comorbidity as moderators of response to the intervention. Reid, Webster-Stratton and Baydar (2004) demonstrated that children who showed high levels of the initial severity of conduct problems, and of mothers with a high initial level of critical parenting benefited most from the intervention. In a meta-analytic review, low family income, low parental education or occupation, more severe initial behavior problems of the child, and maternal psychopathology (especially depression) were linked to poor intervention effect (Reyno & McGrath, 2006).

The present study aimed to evaluate the effectiveness of both the BASIC and ADVANCE components of the IY parent program as an indicated preventive intervention in a population-based sample of parents of preschool children at risk for DBD in the Netherlands. Results at baseline, post-assessment and at follow up one year after termination of the intervention are reported. First, we examined whether the IY parent program improved parenting skills and decreased disruptive child behavior. Based on earlier studies, we expected that the parenting skills of parents who received the intervention improved when compared to control parents who did not receive the Incredible Years parent training. In addition, we expected that the disruptive behavior of children whose parents received in the intervention was reduced due to these improvements in parenting skills when compared to the disruptive behavior of children from control group parents. Several outcome measures of disruptive child behavior were used, e.g., parent- and teacher-rated questionnaires. Considering that parent-ratings of child behavior are often susceptible to systematic biases (Gardner, 2000), an observation of parent-child interaction was also conducted as a more objective measure of child behavior. Observations have been found to be sensitive to change in child behavior as a result of an intervention (Frick & Loney, 2000). Therefore, and based on previous studies into the preventive effectiveness of the IY parent program, we expected to find the reductions in disruptive child behavior and improvements in parenting skills more clearly on our observational measure than on the parent-rated measures. Second, to investigate whether the IY parent program actually prevented the development of DBD we also looked at the DSM-IV criteria. We examined whether the occurrence of DBD differed between the intervention and control group, which has not been done in other preventive evaluations of

the IY parent program. Third, mediational processes were examined to investigate whether the changes in parenting caused the changes in child behavior. In this regard, we expected that the aggressive behavior of the child was reduced and positive behavior was increased as a consequence of the improvements in parenting skills. Fourth, the moderating effect of several child- and parent characteristics on the intervention effect was studied. In this regard, we expected that the initial severity of the aggressive behavior of the child, low IQ, poor executive control, and low levels of autonomic arousal of the child reduced the impact of the IY parent program on aggressive child behavior. Parental stress and psychopathology were also expected to have a negative impact on the intervention effect.

METHODS

Design

A case control design, in which participants were selected to be in either the intervention group (IG) or control group (CG) based on their place of residence, was used in this study. Randomization was not feasible because of geographical and motivational reasons. According to the Standards of Evidence given by the Society for Prevention Research (2005), use of a case control design is permitted "as long as assignment was not by self-selection, but instead by some other factor (for instance geography)". The families to be recruited lived in several different towns and cities in the province of Utrecht, The Netherlands. As motivation to participate is a recurrent problem in intervention studies, especially when families of children with conduct problems are involved (Luk, Staiger, Mathai, Wong, Birleson & Adler, 2001), we wanted to make it as easy as possible for families to participate. It has been shown that offering a preventive intervention for preschool children with disruptive behavior in a hospital results in a low attendance rate; less than half of the participants attended at least 50% of the sessions (e.g., Barkley et al., 2000). To avoid this, we have chosen to deliver the IY program at four different sites which are within 15 km distance from the consenting families' homes and which are also easy accessible, such as community centers. Moreover, the IY program requires at least 6 parents to participate in a parent group to optimize discussion and to foster a sense of support (Webster-Stratton, 2001). Consequently, the location of the IY program had to be close to the homes of the parents and sufficient parents had to live in the same area to form a group. In addition, parents in the control group had to be blind to their condition; they were not informed on the fact that the other group received parent management training. The control group was told that the study was aimed at investigating the development of aggressive behavior in young children. Control group parents were allowed to use regular services for their child's behavior, i.e., care-as-usual, and will be informed on the design of the study retrospectively. Therefore, to prevent the two groups from running into each other, control participants had to live at a considerable distance from the participants in the intervention group, preferably in another town or city (Raaijmakers et al., 2008, Chapter 4). Therefore, a case-control design was used in which families were matched on the child's gender, level of aggression, IQ, the parents' educational level, stress level, and address density of the place of residence of the family. Assessments took place at three points in time: pre-intervention, post-intervention (six months later, directly after termination of the intervention) and at follow-up (one year after termination of the intervention).

Participants

Subjects were acquired by the Office for Screening and Vaccination in the province of

Utrecht, The Netherlands. Parents of 16002 4-year-old children born either in 2000 or 2001 were mailed a Child Behavior Checklist 1½-5 (CBCL; Achenbach & Rescorla, 2000; Dutch version by Verhulst & Van der Ende). More than half of these parents filled out and returned this questionnaire (see Figure 1). Children were selected to participate if they scored at or above the 80th percentile of the Aggressive Behavior scale of the CBCL. The Aggressive Behavior scale consists of 19 items, e.g., 'is disobedient' and 'punishment does not change his/her behavior', which are rated on a three-point scale by one of the parents. In total, 509 children scored at or above the 80th percentile and were considered to be at risk. For the intervention group (IG) 283 families were selected and 226 families for the control group (CG; no intervention, only care as usual), based on their place of residence. Parents were invited to participate by letter and were called maximally two weeks later to ask for their response. If parents were interested in participation, two members of the research team visited the family to explain the procedure of this research project. During this home visit families that were invited to participate in the intervention received additional information on the IY parent program. When parents agreed to participate written informed consent was obtained. Children with an estimated full scale IQ below 80 were excluded from the study. This resulted in 72 families in the IG and 110 in the CG. Reasons for non-participation were that parents did not think of their child as at risk for DBD or as showing a high level of aggressive behavior, family or academic commitments, pressure from partner to decline, language barriers, already involved in other interventions, or we were unable to reach the family. The aggressive behavior score of children whose parents agreed or refused to participate in this study were not significantly different; neither in the IG, nor in the CG. Matching was performed after pre-assessment on 72 intervention families and resulted in 72 matched controls. An independent administrator who was not involved in this research project carried out the matching procedure. Families lost from post-assessment to follow up (2 CG and 1 IG) did not differ significantly in their initial level of aggression from those retained. Attrition of these families was due to, e.g., personal circumstances such as medical conditions of the child or parent, or participation was a too heavy burden for the family. Characteristics of the IG and CG group are depicted in Table 1. Groups did not significantly differ on any of these descriptive characteristics, except for age of the child (t (71) = 2.41, p = .018). All primary caregivers were biological parents, except for one mother from the IG, who was an adoptive parent. Almost all children were Caucasian, only 4.2% was non-Caucasian, 5 children in the IG (6.9%) and 1 child in the CG (1.4%). None of the children used medication at the moment of pre-assessment. Twelve families in the intervention group (17.9%) and 11 families in the control group (15.7%) received other professional help, e.g., psychological or psychiatric assessment of the child, or parents consulted a child psychologist or a youth care center because of their child's behavior, during the intervention phase.

Procedure

Written informed consent was obtained from the participating families. A set of questionnaires was mailed to the parents. Children were assessed at their homes by trained experimenters using standardized instructions. Assessments consisted of an observation of the parent and child playing together, a structured interview with the parent and a task on social information processing and hostile attributions with the child and took approximately one hour. Pre-assessment was more comprehensive for the child and consisted of two home visits in which an IQ-test, several neuropsychological measures, and heart rate and skin conductance measures were included. Children received a small gift for their participation.
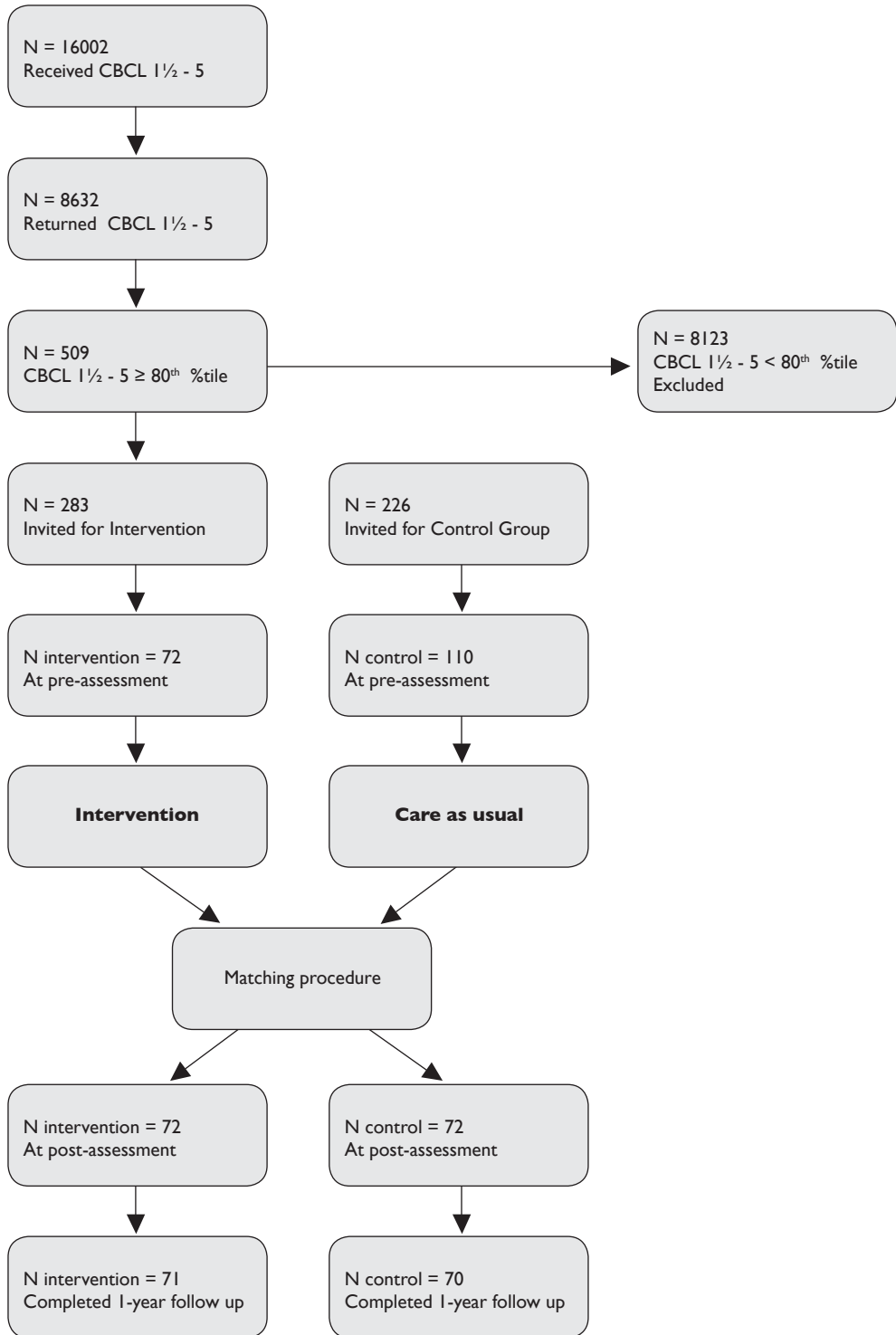
Figure 1. Flow chart of selection and assessments

Table 1 Sample Characteristics by Group

Measure M (SD)	Intervention Group (n=72) M (SD)	Control Group (n = 72)
Child		
Gender (% boys)	70.8	70.8
Age (months)	50.3 (3.11)	51.3 (2.53)
IQ	107.3 (9.87)	107.5 (11.57)
CBCL 1½-5 (raw scores at selection)		
Aggressive Behavior	21.99 (4.37)	22.49 (4.69)
Attention Problems	4.17 (2.22)	4.18 (2.38)
Parent		
Primary caregiver (n)		
Mother	59	66
Father	13	6
Age (years)		
Mother	35.5 (4.84	34.1 (5.49)
Father	37.9 (5.12)	36.8 (4.83)
Civil status (%)		
Married	59.2	78.9
Single	12.7	4.2
Living together	23.9	15.5
Divorced	4.2	1.4
Education (%)		
Primary	-	2.8
Secondary	4.2	5.6
Intermediate vocational	29.2	31.0
Higher vocational	38.9	31.0
University	27.8	29.6

Note. Relation to child and civil status of the primary caregiver are reported; Education denotes the highest educational level of both parents.

Parents received a monetary reward (€25,- for each assessment). The study was approved by the Medical Ethical Review Committee of the Utrecht University Medical Center.

The Incredible Years Parent Program: BASIC and ADVANCE
The IY parent program was originally designed as a treatment for children with a diagnosis of CD (Webster-Stratton, 2001). The IY parent program aims to improve parenting skills and to increase positive parent-child interaction in order to decrease the aggressive behavior of children aged 3-8 years. As mentioned earlier the IY parent program consists of a BASIC and an ADVANCE component. In the BASIC component (Webster-Stratton & Hancock, 1998; Webster-Stratton, 2001) parent groups view video-vignettes of parents interacting with children. After each vignette the group leader asks questions to the parents to stimulate discussion on topics like how to play with your child, praise and rewards, limit setting, and handling misbehavior. Parents are taught to use child-directed play skills, to use less critical and harsh discipline and more positive and consistent strategies. In addition to these discussions, role-playing, modeling, practicing, a book with chapters on each of the topics and home assignments are used to teach parents about parenting skills and parent-child interactions. The ADVANCE program (Webster-Stratton, 2002) elaborates the BASIC program with topics like how to communicate with your child and with adults, giving and getting support, coping with stress and your emotions as a parent, and problem solving. A key characteristic of the IY program is the use of a collaborative model; group leaders establish themselves as part of the group, not as experts, to ensure that the progress made during the intervention

is maintained following program completion. Parents' ideas are valued and highlighted by group leaders resulting in empowerment of the parents. More detailed descriptions of the intervention goals and methods can be found in the manual Webster-Stratton, 2001, 2002), on the website (www.theincredibleyears.com) and have been published (Webster-Stratton, 2000; Webster-Stratton et al., 2001).

In this study, the BASIC and ADVANCE curriculum were delivered in 18 two-hour sessions; 11 BASIC sessions and 7 ADVANCE sessions. Eight groups of parents received the intervention in different towns and cities scattered over the province of Utrecht. After termination of the intervention two booster sessions were offered; the first about three months after the IY parent program was completed and the second about six months after termination. Parent groups were offered in easily accessible locations, such as community centers, to facilitate participation.

Treatment Integrity
Six members of the research team were trained by the program developer during a three-day workshop and became certified group leaders prior to delivering the groups investigated in this study. To become certified, group leaders received supervision from accredited IY trainers. Group leaders had backgrounds in clinical child psychology or child psychiatry. Intervention sessions were videotaped and reviewed during weekly two-hour meetings of group leaders to ensure that the program was delivered with fidelity. In addition, the manual of the IY program was used, and both parental evaluations as well as checklists for group leaders were filled out after every session.

Measures
Neuropsychological assessment
During pre-assessment child had to conduct six neuropsychological tasks measuring working memory, set shifting, inhibition and verbal fluency. Factorscores were computed and aggressive preschool children appeared to be impaired in inhibitory control when compared to a group of typically developing children. For a more detailed description of the neuropsychological assessment see Raaijmakers et al (in press, Chapter 2). In this study, the factorscore *Inhibition problems* was used as a putative moderating variable of the intervention-effect. This factorscore consisted of four variables measuring impairments in inhibition from the computerized Shape School- and Go/No go task ($\alpha = .69$) (Espy, 1997; Smidts, 2003).

Psychophysiological assessment
Children's heart rate and skin conductance level were also measured during pre-assessment. Skin conductance level and reactivity were decreased in the group of aggressive children when compared to a group of typically developing children. For a more detailed description of the psychophysiological assessment see Posthumus, Bocker, Raaijmakers, Van Engeland & Matthys (2008). In this study, we used baseline resting Heart Rate and *Skin Conductance Level* as indicators of low autonomic arousal. Heart rate and skin conductance were measured with the Vrije Universiteit Ambulatory Monitoring System 36 (VU-AMS; Klaver, De Geus & De Vries, 1994) while the children watched a videotape. Both heart rate and skin conductance level were used as putative moderating variables of the intervention-effect.
Wechsler Preschool and Primary Scales of Intelligence (WPPSI-R)
The IQ of the child was assessed during pre-assessment with the WPPSI-R (Wechsler, 1997;

Dutch-Flemish version by Vander Steene & Bos). Subtests Picture Completion, Vocabulary, Block Design and Similarities were used to estimate full scale IQ (correlation of subtests with full scale IQ is .92), following the guidelines of Sattler (1992).

Child Behavior Checklist (CBCL 1½-5)
The level of aggression of the children for recruitment was measured by the Child Behavior CheckList 1½ – 5 Aggressive Behavior (Achenbach & Rescorla, 2000). This scale contains items like "hits others", "does not feel guilty" and "often has temper tantrums". Parents circle the answer that fits the behavior of their child; 'never', 'sometimes' or 'always'. Children were selected to participate if they scored at or above the 80th percentile, which equals a raw score of 16. The borderline range (93rd percentile) contains raw scores from 21 to 23 and scores of 24 and higher are in the clinical range (97th percentile).

Eyberg Child Behavior Inventory (ECBI)
The ECBI (Eyberg & Pincus, 1999) is used to assess the occurrence of disruptive problem behaviors in children aged 2 to 16 years. The ECBI consists of 36 behavioral items which are rated on two scales; an *Intensity Scale,* which measure the frequency of the problem behavior on a 7-point scale (ranging from 'never' to 'always') and a *Problem Scale*, which asks parents to report whether the behavior is perceived to be a problem (yes or no). Several studies have demonstrated acceptable reliability and validity of both scales (e.g., Boggs, Eyberg & Reynolds, 1990; Eyberg & Pincus, 1999; Rich & Eyberg, 2001). In this study, Cronbachs α was .91 for the *Intensity scale*, and .88 for the *Problem scale*.

Diagnostic Interview Schedule for Children Parent version (DISC-IV-P)
The parent version of the Disruptive Disorder module (E) of the DISC-IV (Shaffer, Fisher, Lucas, Dulcan, Schwab-Stone, 2000) was used to assess three disorders: Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). This highly structured diagnostic interview module was administered and scored by trained master students. The interview was administered during a home visit or by telephone and took approximately 45 minutes.

Dyadic Parent-child Interaction Coding System - Revised (DPICS-R)
The DPICS-R (Eyberg & Robinson, 1981; revised 2000) is an observational measure used to assess the quality of parent-child interactions at home. Parent and child were observed for 20 minutes while playing with a fixed set of toys, at pre-, post-, and follow-up assessment. The observation was videotaped and coded later on. The observation consisted of four five-minute periods; in the first period parent and child played like they would usually do to get used to being videotaped, in the second period the child picked a toy and decided what happened during the play session (child directed play, CDI), in the third period the parent picked a toy and decided what happened (parent directed play, PDI), in the final period the parent had to make the child clean up the toys (clean up, CU). For each period, parenting skills and child behavior were coded separately into 47 categories; 24 for parent behavior (e.g., statements or positive affect) and 23 for child behavior (e.g., physical warmth or smart talk). In this study, parental behavior categories *Critical Statements and Labeled* Praise were used. With respect to child behavior, a composite score of the categories Smart Talk, Cry/Whine/Yell, and Physical Negative was used. This composite score was labeled *Negative Child Behavior* (α = .51). In addition, the category *Comply* was used as a measure of child behavior.

A proportional compliance-score was constructed; the number of complies of the child was divided by the number of commands given by the parent. Trained master-students and trained project staff had to achieve an interrater-reliability of 70% before coding parent and child behaviors into these categories. In addition, the quality of scoring was monitored continuously by having 20% of the observations checked by a second rater.

Parent Practices Interview (PPI)
This parent-rated questionnaire (Webster-Stratton, 2001) was designed to measure parenting skills or discipline styles of parents of young children. The PPI consist of 15 questions, each with several aspects, asking for a response of the parent to misbehavior, appropriate behavior and to several statements. Parents could answer to these questions and respond to the statements on a seven-point Likert-scale, ranging from 'not (likely) at all' to 'always/ very likely'. Seven summary scales were extracted from this questionnaire; *Appropriate Discipline* (e.g., actually disciplining the child when it misbehaves, 12 items, α = .74), *Harsh & Inconsistent Discipline* (e.g., threatening, but not punishing, 15 items, α = .81), *Positive Verbal Discipline* (e.g., discussing the problem with the child, 9 items, α = .67), *Monitoring* (e.g., supervision of child activities, 5 items, α = .35), *Physical Punishment* (e.g., slapping or hitting when misbehavior occurs, 6 items, α = .87), *Praise & Incentives* (e.g., giving a hug or compliment, 11 items, α = .73) and Clear Expectations (e.g., clear rules about going to bed, 6 items, α = .65). All scales demonstrated acceptable reliability, except for Monitoring. Therefore, this scale was excluded from the analyses.

Parental Stress Index (PSI)
The PSI (Abidin, 1990; Dutch version (NOSI) by De Brock, Vermulst, Gerris, & Abidin, 1992) was designed to measure stress of parents or caregivers in a pedagogical context. In this study stress of the parents was assessed by four subscales of the PSI: *Role Restriction* (the extent to which the parent thinks of his/her parental role as a restriction of his/her own freedom; 7 items), *Health* (somatic or physical problems the parent experiences; 6 items), *Isolation* (feelings of loneliness and lack of social support; 6 items) and *Spouse* (satisfaction in the marital relation between partners; 7 items). Parents' responses to the statements of this questionnaire were rated on a six-point Likert-scale, ranging from 'totally disagree' to 'totally agree'. The Dutch version of the PSI has demonstrated adequate reliability and validity (De Brock et al., 1992). Reliability of the four scales used in this study was acceptable; *Role Restriction* α = .80, *Health* α = .80, *Isolation* α = .69, and *Spouse* α = .78. The scores of the four subscales were added up in order to calculate a *Total Stress Score*.

Symptom Checklist (SCL-90)
The SCL-90 (Arrindell & Ettema, 2003) is a multidimensional checklist based on self-report with adequate psychometric properties. In this study parents filled out three subscales of the SCL-90: *Fear* (a high level of fear, arousal, tension and panic, 10 items, α = .86), *Depression* (hopelessness, depressed moods, 16 items, α = .92), and *Somatic Complaints* (physical dysfunction, e.g., headaches or nausea, 12 items, α = .85). Parents were asked to report to what extent (not at all, a little, quite a bit, a lot, very much) they experienced fear, depression, and physical complaints in the past week.

Teacher's Report Form (TRF)
Teachers of the participating children were asked to fill out the TRF (Achenbach & Rescorla,

2000). This widely used checklist consists of 118 items to assess the behavior problems of the child as experienced by the teacher in the classroom. Teachers circle the answer ('never', 'sometimes' or 'always') that fits the behavior of the child in the preceding two months. Two symptom scales, similar to those of the CBCL, were used in this study; *Attention Problems* and *Aggressive Behavior.* Both scales were found to be reliable with Cronbachs αs of .86 and .94 respectively.

Parent Satisfaction Questionnaire (PSQ)
The PSQ was designed by Webster-Stratton (1989) and adapted from the work of Forehand and McMahon (1981) to assess the level of satisfaction of parents who participated in the IY parent program. After the 11 sessions of the BASIC component of the program and directly after termination of the entire intervention (including the ADVANCE component) parents filled out a comprehensive satisfaction questionnaire. Parents rated the usefulness and difficulty of the overall content, teaching methods, group dynamics, videotape vignettes, and specific parenting techniques. Questions were rated on 7-point Likert scales, ranging from extremely difficult/ useless (1) to extremely easy/ useful (7). Five summary scale scores were calculated for the BASIC and ADVANCE program together: *Overall Program Satisfaction* (11 items, α = .76), *Teaching Format-Usefulness* (13 items, α = .70), *Specific Parenting Techniques - Difficulty* (16 items, α = .64), *Specific Parenting Techniques - Usefulness* (15 items, α = .82), and *Leader Satisfaction* (10 items, α = .89).

DATA ANALYSIS

Assessments took place at three points in time: pre-intervention, post-intervention (six months later, directly after termination of the intervention) and at follow-up (one year after termination of the intervention). Intervention-effects were evaluated based on intention-to-treat analyses; data from all participants who completed pre-assessment were included in analyses on each moment of assessment, irrespective of the level of uptake of the intervention. Due to a low level of attrition, missing data were not imputed. If a scale score was missing of a family, the same scale score for the matched family was removed as well. Scale scores of participants were excluded from the analyses when 25% or more of the data was missing.

First, overall intervention effects were examined. To account for the person-to-person based matching performed in this study, paired samples t-tests were used. Mean difference scores were used to investigate whether the changes in parenting practices and child behavior differed between the groups over time. Analyses were conducted on difference scores of the primary caregiver from pre- to post-assessment, post- to follow up assessment, and from pre- to follow up assessment for both groups (see Tables 2a and 2b). Using difference scores over time ensures that baseline levels of parenting and child outcomes are controlled in the analyses. These difference scores were calculated by subtracting scores from the first moment of assessment from the scores from the later moment of assessment (e.g., post-assessment scores minus pre-assessment scores), such that a higher difference score represents a larger change over time in parenting or child behavior. To compare the IG and CG the differences between the mean difference scores over time were examined. Subsequently, group means were explored to investigate the direction of the effects. Effect sizes were calculated based on Cohen's *d* (and evaluated as 0.2 = small effect, 0.5 = medium effect, and 0.8 = large

effect; Cohen, 1992); the difference in mean difference score over time between IG and CG was divided by the standard deviation of the mean difference score over time of the entire sample. Positive t-values and positive effect sizes (d) indicate beneficial effects for the IG. In addition, DISC-diagnoses at follow up assessment were analyzed, using χ^2-analyses, to see whether the IY parent training prevented the development of DBD. Two-tailed tests and the criterion of $p < .05$ were used in all analyses. Second, mediational processes were examined in order to identify mechanisms of change. A structural equation model was constructed to investigate mediating effects of parenting on the outcome variables that demonstrated significant effects. Third, moderation was investigated. Interaction terms of group and several putative moderating variables were entered in regression analyses to see whether these variables functioned as moderators of the intervention effect. In both the analyses of mediation and moderation, the matching was not taken into account to avoid statistical complications. Analyses were performed using SPSS 15.0 (2006) or AMOS 7.0 (Arbuckle, 2006).

RESULTS

Baseline comparisons
Means and standard deviations at pre-assessment are depicted in Table 2a. Paired samples t-tests revealed no significant differences between IG and CG for any of the parent-reported measures at pre-assessment. However, several significant differences between IG and CG were found on observed behavior of both parents and children. Parents differed on the number of *Critical Statements,* with IG parents being more critical than CG parents (t (63) = 2.08, $p = .04$). Both measures of child behavior, *Comply* and *Negative Child Behavior*, differed significantly over the groups at pre-assessment (Comply: t (65) = -7.02, $p = .00$; Negative Child Behavior: t (65) = -2.86, $p = .01$). IG children were significantly less compliant and showed more negative child behavior than CG children.

Attendance
An average of 14 sessions was attended by at least one of the parents, i.e., the attendance rate was 78%. Most parents attended the parent group as couples (43%), 14% of the parents were single mothers, 12% of the parents took turns, and 25% of the mothers and 6% of the fathers attended the parent group alone. If a parent was unable to participate group leaders called and tried to meet with this parent individually prior to the subsequent session to discuss the missed content. All families completed the intervention period. Only two parents attended just one session (3%) and 92% of the parents attended at least 9 sessions. The level of attendance did neither affect parent-, nor child outcomes significantly.

Parental Satisfaction with the IY program
The five summary scale of the PSQ were rated on a scale from 1 to 7, with a high score indicating a high level of satisfaction, difficulty or usefulness. Parents were very positive about the IY program and no differences in satisfaction between the eight parent groups were found. *Overall Program Satisfaction* was high ($M = 5.6$, $SD = 0.51$) and the *Teaching Format* was perceived as useful ($M = 5.1$, $SD = 1.00$). The *Difficulty of Specific Parenting Techniques* was rated as neutral by parents; parenting techniques were neither difficult, nor easy ($M = 4.4$, $SD = 1.01$) and the *Usefulness of Specific Parenting Techniques* was rated as high ($M = 5.7$, $SD = 0.75$). Parents were also highly satisfied with their group-leaders (*Leader Satisfaction: M =*

6.5, *SD* = 0.37). Parents would recommend this program to friends or relatives (94.2%) and felt supported by the group (92.5%). Moreover, 94.2% of the parents felt that they were now capable of handling the child's behavior effectively.

Results at pre-, post- and follow-up assessment
Means and standard deviations for IG and CG are depicted in Table 2a. Table 2b displays the results of the paired-samples *t*-tests and effect sizes.

DPICS: Observed Parenting
Pre-post-comparisons demonstrated significant group effects on observed parenting in favor of the IG. The IG showed a significantly larger decrease in *Critical Statements* than CG, and IG significantly increased in the use of *Labeled Praise*, whereas the CG showed a slight decrease. The effect size of *Critical Statements* indicated a small to medium effect and the effect size of Labeled Praise was indicative of a large effect. From post- to follow up, the effect on *Critical Statements* was mitigated; the IG showed a larger decrease than CG, but this difference was not significant. The significant effect on *Labeled Praise* from post to follow up was indicative of a small effect in the opposite direction, reflecting a slight increase in *Labeled Praise* in CG and a decrease in IG. Pre-follow up-comparisons revealed that the overall effect on *Critical Statements* remained positive over time, with an effect size similar to the pre-post comparison. The decrease in *Critical Statements* in the IG was significantly larger than the decrease in the CG from pre- to follow up assessment. In contrast, the pre-post-difference on *Labeled Praise* did not remain significant over time, which was also reflected by a large decrease in effect size. However, this effect did point in the expected direction, in contrast to post-follow up analyses, with the IG showing a larger increase in the use of Labeled Praise than CG.

DPICS: Observed Child Behavior
In pre-post comparisons, no significant effects were found on observed child behavior. However, change in both *Comply* and *Negative Child Behavior* pointed in the expected direction, with the IG showing more improvement than CG. From post- to follow up assessment a significant effect on *Comply* became apparent, with a small effect size. IG children showed an increase in compliance to parental commands, whereas CG children's compliance decreased. Pre-follow up-comparisons revealed significant effects in favor of the IG on both variables. *Comply* increased over time in both groups, but the IG showed a significantly larger increase than CG. Furthermore, with respect to *Negative Child Behavior* a significant effect in favor of the IG appeared with a medium effect size.

PPI: Parent-rated parenting
Mean difference scores from pre- to post-assessment revealed several significant differences in parenting skills between the IG and CG. Intervention effects on *Appropriate Discipline*, *Harsh & Inconsistent Discipline* and *Praise & Incentives* were found. Effect sizes were medium to large. All effects found pointed in the expected direction, with the IG showing significantly larger improvements in parenting than CG. Between post- and follow up assessment, a new significant effect appeared in an unexpected direction: *Positive Verbal Discipline* decreased in both IG and CG, but more in IG parents. In addition, although no significant effects were found on the other parenting scales, almost all effects were reversed, and were indicative of improvements in parenting for CG- instead of IG parents; only the effects on *Praise & Incentives* and *Clear Expectations* were not reversed. Pre-follow up-comparisons showed positive

overall effects on *Appropriate Discipline*, *Harsh & Inconsistent Discipline* and *Praise & Incentives* over time. The effect found on *Positive Verbal Discipline* in post-follow up analyses was not found in the pre-follow up comparisons. All effects found pointed in the expected direction, similar to pre-post-comparisons, with the IG showing larger improvements in parenting than CG. However, effect sizes decreased when compared to pre-post analyses; effects sizes were now in the medium range.

ECBI: Parent-rated child behavior
No significant differences between the groups were found over time.

TRF: Teacher-rated child behavior
No significant pre-post differences between the groups were found. From post to follow up, a significant effect appeared on Attention Problems; in the IG *Attention Problems* decreased, whereas in the CG *Attention Problems* increased over time. The effect size of *Attention Problems* was small. Pre- follow up comparisons did not reveal significant effects.

DISC: Parent-rated child behavior at Follow up
At follow up one year after the intervention the distal variable, i.e. the prevention of DBD diagnoses in children, was examined. DISC-diagnoses at follow up assessment were analyzed to see whether the IY parent training prevented the development of DBD. Percentages of diagnoses at each moment of assessment are displayed in Table 2a. At follow up, χ^2-analyses did not reveal significant differences between the groups; neither in the presence of DBD (χ^2 (1) = 0.01, p = .54), nor in the presence of ADHD (χ^2 (1) = 0.02, p = .52).

Mediation
To investigate whether the change in parenting skills functioned as a mediating mechanism of the intervention effect a theoretical model was constructed and the analyses were conducted in AMOS (Arbuckle, 2006). By testing for a mediational effect, we wanted to explore whether the improvements in parenting behavior explained the relationship between treatment status and child behavior outcomes. Intervention effects reported earlier demonstrated that only observed child behavior significantly improved, therefore we chose to construct a model of observed parenting and child behavior. With respect to parenting, *Critical Statements* and *Labeled Praise*, and with respect to child behavior *Comply* and *Negative Child Behavior* were employed separately in the mediation analyses. By including only one observed variable for each construct, no latent constructs were involved.

In order to examine at which moment the mediating effect appeared, we decided to construct two models. In the first model observed parenting variables at pre- and post-assessment were included as mediators of observed child behavior at post-assessment, as has been done by Gardner, Burton, & Klimes (2006). The second model included the same mediating variables, but now child behavior at follow up-assessment was used as the outcome measure, as suggested by Eddy, Dishion and Stoolmiller (1998) who recommend the use of at least 3 data collection points in order to show that improvement in parenting skills precedes the change in child behavior (Kraemer, Stice, Kazdin, Offord & Kupfer, 2001). If improvement of parenting skills influenced child behavior before post-assessment, this influence will be established synchroniously at post-assessment. If improvement in parenting skills is achieved before post-assessment, whereas improvement in child behavior is shown later on, the influ-

Table 2a. Intervention effects: Means and Standard Deviations

| | | Pre | | | | Post | | | | FU | | | |
	N	IG M	(SD)	CG M	(SD)	IG M	(SD)	CG M	(SD)	IG M	(SD)	CG M	(SD)
Observed													
Parenting: DPICS													
Critical Statements	63	8.78	(8.00)	6.25	(4.78)	4.89	(5.26)	5.24	(4.46)	3.25	(3.20)	4.23	(4.43)
Labeled praise	63	0.56	(1.01)	0.44	(0.76)	1.71	(2.83)	0.41	(0.69)	0.98	(1.67)	0.51	(1.30)
Child Behavior: DPICS													
Comply	65	41.19	(15.42)	45.53	(13.80)	47.82	(15.60)	50.16	(13.33)	53.53	(15.34)	47.96	(13.58)
Child negative Behavior	65	8.48	(12.83)	3.63	(5.22)	3.98	(6.46)	0.90	(1.96)	2.15	(4.84)	2.49	(4.70)
Parent- or teacher rated													
Parenting: PPI													
Appropriate Discipline	69	49.22	(10.33)	50.41	(9.29)	53.79	(9.42)	49.19	(9.04)	53.74	(7.19)	49.63	(8.54)
Harsh & Inconsistent Discipline	69	46.17	(9.29)	43.95	(9.99)	39.63	(7.81)	42.97	(9.96)	40.81	(9.79)	42.47	(10.23)
Positive Verbal Discipline	69	50.04	(6.05)	49.34	(5.96)	51.45	(4.99)	49.37	(5.92)	44.65	(5.93)	45.37	(7.05)
Physical Punishment	67	9.70	(4.43)	10.13	(4.49)	8.24	(4.23)	9.66	(4.31)	7.95	(2.52)	8.60	(3.50)
Praise & Incentives	68	47.09	(8.01)	45.43	(7.33)	52.48	(6.51)	44.71	(7.58)	51.03	(5.43)	43.19	(6.88)
Clear Expectations	68	21.71	(3.64)	21.54	(3.87)	21.85	(3.83)	21.47	(2.94)	23.22	(3.79)	22.61	(4.79)
Child Behavior: ECBI													
Intensity	67	127.94	(24.92)	126.16	(27.55)	118.06	(25.62)	121.03	(27.65)	119.22	(24.96)	119.39	(25.74)
Problem	53	12.09	(6.86)	11.15	(7.31)	10.00	(6.40)	11.19	(8.64)	10.40	(7.77)	10.42	(8.35)
Child Behavior: TRF													
Aggression	51	54.82	(5.79)	55.94	(7.03)	55.78	(5.85)	54.32	(5.24)	56.98	(6.38)	57.59	(7.77)
Attention problems	52	55.62	(5.87)	57.38	(8.12)	55.70	(6.05)	54.56	(5.96)	52.29	(3.11)	57.50	(7.72)
Child Behavior: DISC													
DBD (%)	68	62.5		51.4		62.5		48.6		39.4		40.0	
ADHD (%)	68	43.1		47.2		34.7		41.7		30.6		29.2	

Note. All scores are raw scores, except for TRF-scores, those are T-scores; PPI = Parent Practices Interview; DPICS = Dyadic Parent Child Interaction Coding System; ECBI = Eyberg Child Behavior Inventory; TRF = Teacher's Report Form; DISC = Diagnostic Interview Schedule for Children; Pre = pre-assessment; Post = post-assessment; FU = follow up assessment.

Table 2b. Intervention effects: t- and p-values, and Cohen's d

	Pre - Post			Post - FU			Pre - FU		
	t	p	d	t	p	d	t	p	d
Observed									
Parenting: DPICS									
Critical Statements	2.339	.023	.41	0.436	.665	.13	2.364	.021	.47
Labeled praise	3.516	.001	.83	-2.206	.031	-.40	1.718	.091	.32
Child Behavior: DPICS									
Comply	0.646	.520	.07	2.564	.013	.40	2.855	.006	.41
Child Negative Behavior	1.790	.078	.16	0.188	.852	.11	1.998	.050	.46
Parent- or teacher rated									
Parenting: PPI									
Appropriate Discipline	3.570	.001	.58	-1.305	.197	-.15	2.503	.015	.45
Harsh & Inconsistent Discipline	4.893	.000	.80	-1.546	.127	-.30	2.672	.010	.41
Positive Verbal Discipline	1.373	.174	.24	-3.163	.002	-.50	-1.323	.191	-.23
Physical Punishment	1.704	.093	.29	-1.342	.185	-.20	0.752	.455	.10
Praise & Incentives	4.671	.000	.70	0.556	.580	.11	3.204	.002	.58
Clear Expectations	0.343	.733	.05	0.211	.833	.06	0.249	.805	.02
Child Behavior: ECBI									
Intensity	1.291	.201	.23	-0.451	.653	-.15	0.513	.609	.09
Problem	1.093	.280	.32	-0.317	.753	-.11	0.696	.489	.19
Child Behavior: TRF									
Aggression	-1.292	.202	-.26	1.853	.070	.32	-0.451	.654	-.14
Attention problems	-1.097	.278	-.24	2.084	.042	.23	0.745	.460	.15

Note. All analyses were paired samples t-tests; Positive t-and d-values are indicative of effects in favor or the intervention group; PPI = Parent Practices Interview; DPICS = Dyadic Parent Child Interaction Coding System; ECBI = Eyberg Child Behavior Inventory; TRF = Teacher's Report Form; Pre = pre-assessment; Post = post-assessment; FU = follow up assessment.

ence of parenting skills will be established at follow up assessment. The model structure we used to examine mediation is depicted in Figure 2. Prior to the mediational analyses it is necessary to show that variables *Treatment Status* and *Parenting* at post-assessment and *Child Behavior* at post- or follow up assessment are correlated (Baron & Kenny, 1986). *Treatment Status* only correlated significantly with *Comply* at follow up ($r = .198$, $p < .05$) as outcome measure. Therefore, only the models in which *Comply* at follow up was the outcome measure were tested.

The model structure (Figure 2) was used to test two different models of observed parent and child behavior: 1) mediation by *Labeled Praise* of *Comply* at follow up, and 2) mediation by *Critical Statements* of *Comply* at follow up. First, the relation between *Treatment Status* and *Comply* at follow up was examined ($B = .198$, $p = .02$). Next, to explore mediating mechanisms, parenting variables at pre- and post-assessment were added and the relation between *Treatment Status* and *Comply* at follow up was analyzed again. In order to prevent the model from being saturated, the path from Treatment Status to parenting at pre-assessment was restrained to zero, because no differences at pre-assessment were expected.
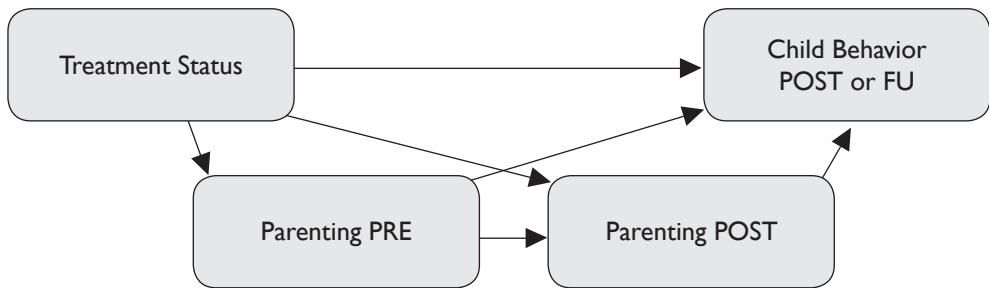

Figure 2. Mediation: Model structure of observed parenting and child behavior.
Note. PRE = measured at pre-assessment, POST = measured at post-assessment, FU = measured at follow up.

This resulted in a fitting model when Labeled Praise was used as a mediating variable, but not when *Critical Statements* was used. Therefore, the restriction of the path from *Treatment Status* to parenting at pre-assessment was dropped in the model including *Critical Statements*. Results and model fit of the two different models are presented in Table 3. As is shown in Table 3, the results revealed a negligible mediating effect of *Labeled Praise* on *Comply* at follow up; by adding *Labeled Praise* to the model, the standardized regression weight of the relation between *Treatment Status* and *Comply* at follow up slightly decreased ($B = .183$, $p = .04$). *Critical Statements* was not found to mediate the effect on *Comply* at all.

Moderation
The moderating influence of several parent and child characteristics on the intervention-effect was explored. Putative moderating variables were parental Stress and psychopathology (*Fear, Depression* and *Somatic Complaints*), the child's *IQ, Heart Rate, Skin Conductance Level, Inhibition problems*, and the *Initial level of Aggression*, all defined at pre-assessment. At pre-assessment, groups did not significantly differ on any of these putative moderating variables. To investigate the moderating influence, the interaction term of group (IG = 1 and CG = -1) and these putative moderating variables was calculated (Baron & Kenny, 1986). Next, group status, one of the putative moderating variables, and the interaction term were entered into a regression

analysis to determine the presence of an interaction effect. Inspection of the data revealed that the variables *Inhibition problems, Fear, Depression and Somatic Complaints* were highly skewed. In order to normalize the distribution of these variables logistic transformations were carried out and the transformed scores of *Inhibition problems, Fear, Depression* and *Somatic Complaints* were used in the regression analyses. Either observed or parent-rated child behavior pre-post difference scores were entered separately as the dependent variable in the regression analyses to investigate which variables moderated direct intervention-effects.

Table 3. Results and Fit Indices of the Mediational models

	χ^2	df	$p (\chi^2)$	B	p	CFI	RMSEA
Model							
Treatment status – Comply FU	-	-	-	0.198	0.02	-	-
1) *Labeled Praise - Comply FU*							
Labeled Praise – Comply	0.13	1	0.72	0.061	0.50	1.00	0.00
Treatment Status – Comply	-		-	0.183	0.04	-	-
2) *Critical Statements - Comply FU*							
Critical Statements – Comply	0.00	0	-	0.118	0.18	1.00	0.00
Treatment status – Comply	-	-	-	0.199	0.02	-	-

Note. In model 1 the path coefficient was restrained to 0, in model 2 the path coefficient was not restrained; Labeled Praise and Critical Statements were measured at post-assessment; Comply was measured at follow up assessment; B = standardized regression weight; FU = Follow Up.

Moderation of observed intervention-effects

The DPICS was used as the outcome measure of observed intervention effects to investigate moderation. First, *Comply* (pre-post difference score) was entered into the regression analysis as the dependent variable. Only *IQ.* of the child yielded a significant moderation effect: $B = -.46, F (1, 133) = 24.71, p = .01$. This implies that the intervention-effect on the *Comply* difference score varied with the child's *IQ.* Inspection of the regression equations of both groups showed that a higher *IQ.* score in the IG goes together with negative change in the *Comply* difference score, whereas a higher *IQ.* score in the CG implies a positive change in *Comply.* This indicates that the intervention was most effective for children with a low *IQ.*

Second, the observed *Negative Child Behavior* pre-post difference score was entered as dependent variable in the regression analysis. A significant moderation effect was revealed by Stress of the parent: $B = -.09, F (1, 134) = 3.56, p = .05$), implicating that the response to the intervention differs with different levels of stress. Inspection of the regression equations for both groups showed that a higher *Stress* score in the IG goes together with positive change in the *Negative Child Behavior* difference score, whereas a higher Stress score in the CG leads to slightly negative change in *Negative Child Behavior.* Thus, the intervention was found to be most effective when a high level of parental *Stress* was present. However, this finding must be interpreted with caution, because there was only a slight linear relation between the variables due to the small variance in the *Negative Child Behavior* difference score.

Moderation of parent-reported intervention-effects

The ECBI pre-post difference score was used as the outcome measure of parent-reported intervention effects to investigate moderation. First, the *ECBI intensity* (difference) score was entered into the regression analysis as the dependent variable. *IQ* of the child was the only

putative moderator variable that yielded a significant effect: *IQ* (B = .32, F (1, 142) = 2.50, p = .05). This significance implicate that there is a different pattern of intervention outcomes for children with high or low *IQ*. Inspection of the regression equations of IG and CG showed that a higher *IQ* score in the IG leads to negative change in the *ECBI intensity* (difference) score, whereas a higher *IQ* score in the CG goes together with positive change in the *ECBI intensity* (difference) score. This indicates that the intervention was most effective for children with a low *IQ*.

Second, the *ECBI problem* (pre-post difference) score was entered as the dependent variable and a significant moderating effect was found for *Inhibition problems* (B = -5.0, F (1, 141) = 2.69, p = .02). The response to the intervention differs with different levels of inhibitory control of the child. Inspection of the regression equations of IG and CG revealed that a higher level of Inhibition problems in the IG goes together with positive change in the *ECBI problem* (difference) *score*, whereas a higher level of *Inhibition problems* in the CG leads to negative change in the *ECBI problem* (difference) *score*. Since Inhibition was a measure of impairment in inhibitory control, this indicates that the intervention was most effective for children with a high level of *Inhibition problems* (i.e., children who showed a high level of impairment in inhibitory control).

DISCUSSION

This population-based study evaluated the preventive effectiveness of the Incredible Years parent training for parents of 4-year-old children at risk for DBD. The prerequisites for finding intervention effects were present: we successfully involved parents in the IY program, resulting in a high attendance rate and a high level of program satisfaction. As expected, IY parent training was found to improve parenting skills. The observation revealed a decrease in critical statements and an increase of labeled praise directly after the intervention. The decrease of critical statements was maintained over time. Furthermore, parents reported an increase in the use of appropriate discipline and praise and incentives, whereas the use of harsh and inconsistent discipline decreased, and these effects were maintained over time. In addition, in line with our hypothesis, observed child behavior improved over time: children became more compliant and showed less negative behavior one year after the intervention. In contrast, parents and teachers did not report an improvement in the child's behavior, and no difference in the presence of DBD diagnoses between the groups was found. Although several effects of the intervention were revealed on parenting skills as well as on observed child behavior, evidence for parenting practices as a mediating mechanism was not found. With respect to moderation, observed intervention effects on the child's behavior were moderated by parental stress and the child's IQ, whereas parent-rated intervention effects on child behavior were moderated by inhibitory control and IQ of the child. Children with a low IQ or poor inhibitory control, and parents with a high level of stress were found to benefit most from the intervention.

To our knowledge this is the first study which evaluated the preventive effectiveness of the BASIC and ADVANCE components of the IY parent program in a population-based sample of 4-year-old children, including mediation and moderation, and which examined the presence of diagnoses of DBD to assess the impact of the intervention. As expected based on previous research into the preventive effectiveness of the IY parent program, sustained

intervention benefits in parent-rated and observed parenting practices were demonstrated. This adds to the body of literature on maintained improvements in parenting skills as a result of this preventive intervention in disadvantaged and high risk families (Hutchings et al., 2007; Webster-Stratton et al., 2001); our findings demonstrate that these improvements can also be found in a population-based sample of non-disadvantaged families with children at risk for DBD. Moreover, evidence for the hypothesized reduction in disruptive child behavior and increase in positive child behavior was also found; effects on observed child behavior emerged and improved significantly over time in this sample of non-disadvantaged families. However, parent- and teacher-reported aggressive behavior did not decrease over time. Several studies into the preventive effectiveness of the IY parent program reported similar findings. Webster-Stratton (1998) reported a decrease in observed conduct problems in Head Start children, but this was not supported by parents or teachers. In addition, Brotman et al (2008) reported improvements in observed child behavior in a sample of children at risk because of an adjudicated sibling, but these improvements were absent in parent-rated child behavior.

The absence of parent-reported intervention effects on child behavior might reflect that observation is necessary to prove effect in prevention research (Brotman et al., 2008). Prevention implicates that the initial severity of the aggressive behavior problems is relatively low, which interferes with the detection of improvements in child behavior by caregivers. Due to these initial low levels of aggression, parents might not experience much burden of the child's behavior and might therefore be less sensitive to change, since the degree of burden that parents experience due to their child's behavior problems is likely to influence their awareness of these problems (Angold, Messer, Stangl, Farmer & Costello, 1998). Moreover, even in some treatment studies there are indications of stronger effects on observed than parent-reported child behavior. In the study of Gardner et al (2006) into the effectiveness of the IY parent program in clinically referred children, both parent-reported and observed reductions in conduct problems were demonstrated, but the effect sizes of observed child behavior were larger than those of parent-reported behavior.

In addition, parent-reported intervention effects might not have been found because parents from the intervention group might have been less reluctant to report aggressive behavior problems due to their participation in a parent group, whereas control group parents might hesitate or report socially accepted ratings of their child's behavior (Webster-Stratton, 1998). Parents who participated in the intervention might also have learned to perceive more of their child's behavior and as a consequence also became more aware of their child's negative behavior due to the intervention. Furthermore, it might be that due to the enduring cognitions parents have developed of their child over the years, parental perceptions of changes in child behavior do not immediately follow the child's actual behavior changes (LeMarquand et al., 2001). This might also explain the finding that the IY parent training did not prevent DBD diagnoses, as assessed by a parental interview, in this study. Parent-rated intervention effects might appear later and to reveal these possible 'sleeper effects' long term follow up is required (Boisjoli, Vitaro, Lacourse, Barker & Tremblay, 2007; Gillham, Shatté & Reivich, 2001; Greenberg, Domitrovich & Bumbarger, 2001; Kendall & Kessler, 2002).

Similar to parents, teachers reported no effects of the intervention on child behavior. The initial severity of the aggressive behavior problems in the classroom was very low, which might have impeded the detection of improvements in child behavior at school. A compli-

cating matter in the interpretation of the teacher-rated results is that at the start of this study not all children in our sample went to school. In the Netherlands, it is mandatory for children to attend school from the age 5 onwards, but almost all children go to school at age 4; the children who participated in this study attended school for only three months on average. Therefore, teachers might have been reticent about reporting behavior problems of preschool children to prevent early stigmatization. In addition, it is likely that aggressive behavior problems do not immediately manifest at school entrance, but children might develop these problems over time. For this reason, long term follow up data are needed to further clarify the effects of the intervention on child behavior at school, since the effects of parent training on child behavior at home are not necessarily generalized to school settings (Scott, 2002; Webster-Stratton & Taylor, 2001).

Furthermore, finding smaller intervention effects in prevention trials than in treatment studies is a recurring phenomenon (Patterson et al., 2004) and might be due to the impact of 'false positives' (Bennett et al., 1998; Offord & Bennett, 2002). In this study, compared to other studies that evaluated the preventive effectiveness of the IY parent program (e.g., Hutchings et al., 2007), a relatively low score on aggressive behavior was found on the ECBI at pre-assessment. Although the presence of false positives can only be assessed retrospectively, this low aggressive behavior score strengthens the assumption of a high number of false positives in our sample. In addition, a relatively low inclusion criterion (80th percentile of the aggressive behavior scale of the CBCL) was used in this study. By employing a higher CBCL-score, e.g., the 93rd percentile, the probability of false positives would have diminished. Due to a high number of false positives, several prevention studies did not find intervention effects for the entire sample, but only for a subsample of children most at risk. This is for example demonstrated in the Fast Track study (Foster, Jones, & Conduct Problems Prevention Research Group, 2006), in which retrospectively almost half of the sample was inaccurately identified as being at risk in spite of an extensive screening procedure. As a consequence small effect sizes were found for the total sample, but in the group of children who were at highest risk of CD the preventive effect as well as the cost-effectiveness of the intervention was established. The screening of the children who were invited to participate in the present study consisted of a single questionnaire administered at one moment in time, and filled out by only one informant. It might be that this screening procedure based on a single measure was not sufficiently accurate to prevent a high number of false positives, especially at this young age (Bennett et al., 1999; Van Lier, Verhulst & Crijnen, 2003). However, a more extensive screening procedure does not guarantee an accurately classified sample as was shown by Foster et al (2006). Therefore, in prevention research efforts to improve the positive predictive value of screening procedures should be continued in order to enhance the (cost-)effectiveness of targeted interventions.

Mediating mechanisms are rarely studied in intervention trials (Rutter, 2005), however, mediation models are necessary to investigate whether parenting practices play a causal role in the development and persistence of conduct problems (Gardner, Sonuga-Barke & Sayal, 1999). In this study negligible evidence of parenting practices as a mediating mechanism of observed child behavior was found. Although the results from the paired samples t-tests demonstrated improvements in observed parenting first, and later in observed child behavior, a temporal sequence which is often interpreted as a indication of mediation (Kraemer et al., 2001), our model did not show significant mediating effects of parenting practices. This

might be due to the fact that the matching was not taken into account in these mediational analyses. By excluding the matching from the mediational analyses, the probability of a significantly mediating influence of parenting was diminished.

In contrast, evidence of moderation of the intervention effect was found; IQ and parental stress moderated observed intervention effects, and IQ and inhibition problems moderated parent-rated intervention effects. However, all moderating effects found were contradictory to our hypotheses; intervention effects were largest for children with a low IQ or poor inhibitory control. A possible explanation for this unexpected finding might be that children with a low IQ or poor inhibitory control are most in need of parental encouragement and a consistent approach from their parents as was taught in the IY parent program. With respect to stress as a moderator, the intervention effect was largest when a high level of parental stress was present. It might be that parents themselves function better as a result of the intervention. Parental stress might be alleviated by the social support from the intervention group and the communication skills taught in the ADVANCE component. However, stress as a moderating variable of observed negative child behavior can not be interpreted as clinically meaningful from this study, because of the small variance in the negative child behavior construct. The duration of the observation was only 15 minutes, which was apparently not long enough to capture a substantial amount of negative child behavior. The low occurrence of certain behaviors is a common problem in observations, especially when the observation covers only a short period of time, and diminishes the quality of observational data (Gardner, 2000; Stormshak, Speltz, DeKlyen & Greenberg, 1997). This might also have negatively affected our mediational analyses. In future research longer and more frequent observations should be used to draw conclusions on mediation and moderating influences on observed negative child behavior. In addition, research into more putative mediators and moderators with more statistically advanced methods is needed to further enhance our understanding of mechanisms underlying this intervention and factors that influence the intervention effects.

This study has a number of limitations that need to be considered. First, this study was not a randomized controlled trial. Although matching can be a viable alternative when randomization is not feasible, it still lacks the opportunity to control for biases due to unobserved variables, which might results in inequality of the groups. Second, and related to this, an unobserved variable which might have influenced the results is motivation to participate. Parents participated on a voluntary basis in this study and this might have resulted in a highly motivated sample and an unintentional exclusion of parents with the most problematic children. Third, at pre-assessment the intervention and control group differed on observed parent and child behaviors. Parents from the intervention group used more critical statements, and children from the intervention group showed more negative behavior and were less compliant. This implies that there was a larger probability of improvement in the intervention group than in the control group, which might have affected our data and our findings must therefore be interpreted cautiously. Fourth, the control group was a care-as-usual condition. Due to the relatively high quality of the care-as-usual in the Netherlands, this might have negatively influenced the effects of the intervention. Fifth, the majority of the parents in our sample showed a high educational level and was Caucasian. We did not succeed in involving less educated parents, which might have introduced bias to our data because children with the more severe aggressive behavior problems often come from less educated families (Côté et al., 2006; Nagin & Tremblay, 2001). Therefore, these findings have limited generalizability to

less educated and non-Caucasian parents and their children. In studies of Webster-Stratton (1998), Webster-Stratton et al (2001) and Brotman et al (2008) the IY parent program has been proven effective in samples of less educated and more disadvantaged parents. In future research, groups with low levels of education and socio-economic status should also be included in studies into the IY parent program in the Netherlands, to see whether these intervention effects could be replicated and to enlarge the generalizability of the results.

In summary, although we did not find a preventive effect of the IY parent program on diagnoses of DBD on the short run, sustained improvements in parenting practices and observed child behavior highlight the potential of the IY parent program as a preventive intervention. More extensive research into mediating mechanisms and moderation of the intervention effect are required in order to investigate how and for whom this preventive intervention is most effective. Long term follow up-, cost-effectiveness-, and dissemination studies are required to assess the feasibility and long term effectiveness (including the prevention of DBD diagnoses) of this program. This study stresses the need for accurate screening and further efforts to develop effective prevention programs for young children at risk for DBD.

Acknowledgements

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Chapter 6

General Discussion
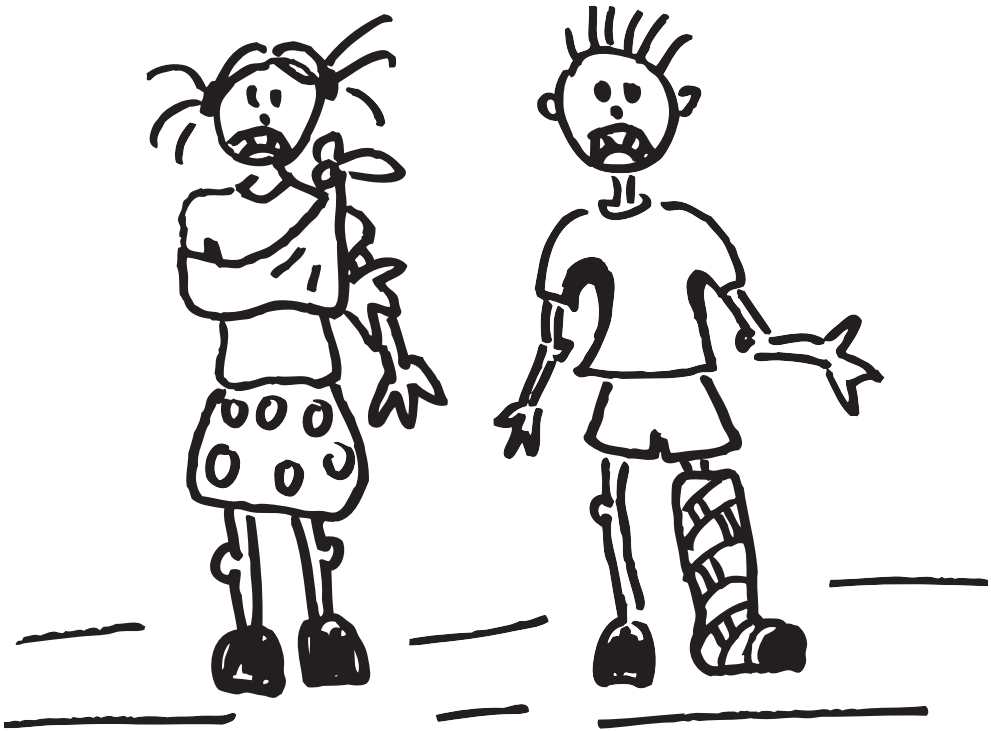
Aggressive behavior in preschool children has been associated with several individual and environmental factors, and might result in negative developmental outcomes. Although aggressive behavior has been found to be stable and persistent over time (Broidy et al., 2003; Tremblay et al., 2004), studies into parent training programs have demonstrated that this behavior is susceptible to change (Brestan & Eyberg, 1998; Eyberg, Nelson & Boggs, 2008). Preventive parenting programs have been designed to improve parent-child interactions in order to reduce aggressive child behavior and to avert the risk for DBD. Research into child- and parent characteristics and evaluations of prevention programs are needed to identify suitable evidence-based interventions for aggressive preschoolers. Therefore, the aim of this thesis was threefold. First, neuropsychological correlates of aggressive behavior in preschool children were investigated (Chapter 2). Second, the costs of service use and the burden on the families of preschool children with aggressive behavior were assessed (Chapter 3). Third, Chapters 4 and 5 reported on methodological issues of intervention research and on the evaluation of the preventive effect of the IY parent training program at one year follow up.

Impairment in Executive Functioning (EF) and aggressive behavior

Research suggests that EF is impaired in children with ADHD, but it remains unclear whether this also applies to children with aggressive behavior or DBD. Impairment in response inhibition has been proposed as the central deficit in children with ADHD (Barkley, 1997), whereas evidence on deficits in children with aggressive behavior is less consistent; working memory, planning, semantic classification and inhibitory control have been found to be impaired in this group of children (Hughes, Dunn & White, 1998; Hughes, White, Sharpen & Dunn, 2000; Speltz, DeKlyen, Calderon, Greenberg & Fisher, 1999). In **Chapter 2** we assessed the neuropsychological performance on tasks measuring working memory, inhibition, set shifting, and verbal fluency of 82 preschool children with aggressive behavior and compared their performance to a group of 99 typically developing control children. Factor analysis revealed that only inhibition could be identified as a distinct factor in this group of children. Compared to the control group, children with aggressive behavior showed impairment in inhibitory control, with girls outperforming boys. This association between inhibition deficits and aggressive behavior was maintained when attention problems were controlled. In line with previous studies (Brophy, Taylor & Hughes, 2002; Oosterlaan, Logan & Sergeant, 1998), our results indicate that impairment in inhibitory control is a robust correlate of aggressive behavior in the preschool period.

In the continuing debate on the question whether EF impairments are related to ADHD, DBD or both (Morgan & Lilienfeld, 2000; Willcutt, Doyle, Nigg, Faraone & Pennington, 2005), our findings argue in favor of the relation between DBD and EF deficits, regardless of ADHD. However, different definitions of aggressive behavior, or DBD, and attention problems, or ADHD, have been used in EF research. This, together with the high rate of comorbidity of these problems, might be partly responsible for the inconsistent results. For example, Hughes et al (1998) investigated EF in a group of 'hard-to-manage' preschoolers without explicitly examining ADHD symptoms resulting in impaired planning and inhibition, whereas Thorell and Wåhlstedt (2006) reported that deficits in inhibition, working memory and verbal fluency were associated with ADHD symptoms, but not with ODD symptoms. To be able to paint a more conclusive picture on EF deficits and its associations with either ADHD or DBD, or both, it might be necessary to clearly distinguish ADHD and DBD and to use similar definitions of these disorders to enhance the comparability of studies. Recently, Rubia et al

(in press) provided a valuable starting point by using a group of boys with pure ADHD, a group with pure CD, and a normal control group in an fMRI study on inhibition. Results demonstrated that, although both the ADHD and CD group showed underactivation of the same brain area when compared to normal controls, the ADHD and CD group showed additional reductions in activation of different brain areas when they were compared to each other. Finding qualitative differences in brain abnormalities between these pure groups implicates that inhibition might be the central deficit in both ADHD and CD. Further investigation of EF in groups with pure ADHD and DBD is needed to clarify the mechanisms underlying the neuropsychological correlates of these disorders.

However, the results of our study must be interpreted in the context of the preschool period in which EF is still fully developing. Since EF is not completely crystallized at the age of 4, and is difficult to assess at young ages due to a lack of appropriate and specific EF measures, our findings cannot be generalized to older age-groups. Future longitudinal studies are required to examine whether the association between inhibition and aggressive behavior is maintained over time and whether these deficits are of predictive value with respect to the development and persistence of DBD.

Impairment in family functioning and high costs of service use
Although a large part of the children with aggressive behavior problems remains untreated (Kazdin & Weisz, 2003), costs of service use have been found to be elevated for school-aged aggressive children (Scott, Knapp, Henderson & Maughan, 2001). In addition, children with aggressive behavior have been found to impose a substantial burden on their families, e.g., by hampering parental functioning at home and at work (Romeo, Knapp & Scott, 2006; Knapp, Scott & Davies, 1999). In **Chapter 3** we investigated whether 4-year-old children who were considered to be at risk for DBD because of a high level of aggressive behavior already differed in impact on family functioning and costs of service use from children with lower levels of aggression. A sample of 317 preschool children was recruited and divided into groups with low, moderate, borderline and clinical levels of aggressive child behavior. Families of children with a borderline or clinical level of aggressive behavior were found to be more impaired in daily functioning than families of children with lower levels of aggression. In line with the studies mentioned above, children with a clinical level of aggression were also more costly than children with a low level of aggression, due to higher costs of services used by the child.

As evident as the findings of preschool children with high levels of aggressive behavior generating high costs and significantly impairing their families might seem, these findings are clinically and financially meaningful. First, this implies that the large number of families of children with aggressive behavior who remain untreated are experiencing an unnecessary burden. The use of mental health care, educational care or youth care is supposed to alleviate this burden and to provide parents with tools to deal with the aggressive behavior of their child. In addition, since maladaptive family functioning is an environmental factor associated with the emergence and persistence of aggressive behavior (e.g., Webster-Stratton & Taylor, 2001), improvements in family functioning as a result of service use might positively influence the child's behavior problems. Although service use of these children will results in higher costs, the burden on the family might be substantially decreased, leading to increased parental productivity at work and less absence from work due to the behavior problems of

the child. It is a challenge for future research to explore ways to engage all families who need it in treatment. Second, the results from our study highlight the potential financial benefits of preventive interventions. Early identification of children at risk for DBD is desirable, because the consequences of children not receiving services for aggressive behavior problems can be serious, clinically as well as financially. From a financial point of view, the preschool period seems to be a right moment to intervene, because the early prevention of life-time persistent aggressive behavior or DBD results in large savings for the individual, the family and society (Cohen, 1998).

Evaluating intervention effectiveness: Study design
A randomized controlled trial (RCT) is the most optimal study design to evaluate intervention effectiveness. By randomized allocation of subjects to the intervention- or control group differences in both observed and unobserved variables are minimized and effects found can be attributed to the intervention instead of a confounding variable (Eccles, Grimshaw, Campbell & Ramsay, 2003; Koek, Hejran & Mintz, 2005). However, RCTs are not always feasible in practice due pragmatic concerns, and alternative study designs have been developed (Harrington, Cartwright-Hatton & Stein, 2002; Barnes, Stein & Rosenberg, 1999). In **Chapter 4** we compared the performance of a case control design to a randomized study design by simulating hypothetical intervention and control groups based on the data in our study on the preventive effectiveness of the IY parent program. Randomization was not feasible due to motivational and geographical reasons. The intervention and control group were matched (person-to-person) on six key characteristics: the child's gender and IQ, the initial severity of aggressive behavior, parental education, parental stress and address density of the family's place of residence. The equivalence of the predefined intervention and control group from our prevention study was compared to the equivalence of the randomized groups. We found that matching using our predefined groups led to a more equally balanced distribution of the six key characteristics than randomization in 34% of the simulated trails, with a maximum of 50%. This indicates that matching in a case control design is a viable alternative when randomization is not feasible.

Notwithstanding the fact that randomization is the most optimal study design in intervention evaluations by removing selection bias and overt bias, a case control design with pairwise matching might be more usable in practice. A vast amount of research conducted in real-life settings cannot be fitted into a RCT because of political, practical or ethical barriers and thus turned to alternative, quasi-experimental designs. Despite the pitfalls of a case control design including pairwise matching, such as selection bias due to inequality of unobserved variables, long term evaluation of intervention effects necessary in prevention research remains possible using this design.

Studies in which designs other than RCTs are employed do provide useful information on intervention effects. Although the results of these studies are not unsusceptible to biases, implications for clinical practice should not only be extracted from results of RCTs, for useful suggestions for adjustment of interventions might be missed. In general, recommendations for policy and practice will be improved by randomized studies using objective measures and with minimal impact of selection biases (Olds, Sadler & Kitzman, 2007). However, the use of different study designs in evaluations of interventions can be viewed as complementary and seems to be a valuable approach. However, in future research more effort should be

made to provide quantative evidence of the methodological soundness when a design other than an RCT is used in order to enhance our understanding of the consequences of non-randomized study designs.

Evaluating intervention effectiveness: Prevention and the IY parent program

Since parenting is the most proximal influence on young children's development and inadequate parenting practices have been associated with the emergence and persistence of aggressive behavior (Côté, Vaillancourt, LeBlanc, Nagin & Tremblay, 2006; Shaw, Lacourse & Nagin, 2005; Tremblay et al., 2004), it is not surprising that parent training programs have been found to effectively reduce aggressive behavior problems in young children (Brestan & Eyberg, 1998; Lundahl, Risser & Lovejoy, 2006; McCart, Priester, Davies & Azen, 2006; Eyberg et al., 2008). The IY parent program emerged as effective from treatment studies (Gardner et al., 2006; Scott, Spender, Doolan, Jacobs & Aspland, 2001; Webster-Stratton & Hammond, 1997; Webster-Stratton & Reid, 2003; Webster-Stratton, Reid & Hammond., 2004), but the evidence on the preventive effectiveness of this program remains inconclusive. In **Chapter 5** we evaluated the preventive effectiveness of the IY parent program (BASIC and ADVANCE) in a population-based sample of 4-year-old children at risk for DBD. Children were matched (see **Chapter 4**), resulting in an intervention group of 72 children and a control group of 72 children. Data were collected by observation and parent- and teacher questionnaires at pre-, post- and follow up assessment (one year after termination of the intervention). Our results revealed significant improvements in both observed and parent-rated parenting in the intervention group, which were maintained over time. In addition, observed child behavior also showed sustained positive intervention-effects. However, parent- and teacher-rated child behavior did not improve, and at one-year-follow up the presence of DBD diagnoses did not differ between the groups. Mediation of child behavior by parenting practices could not be demonstrated in this study. The intervention effect was found to be moderated by parental stress, as well as by the child's IQ and level of inhibitory control. Children with a low IQ or poor inhibitory control, and parents with a high level of stress were found to benefit most from the intervention.

In sum, our study demonstrated the promising character of the IY parent program as a preventive intervention for preschool children at risk for DBD, as shown by improvements in observed child behavior at follow up. However, in line with previous studies (Brotman et al., 2008; Webster-Stratton, 1998) parent- and teacher ratings of child behavior did not report these improvements. Several possible explanations of the absence of parent-rated improvements in child behavior were discussed, e.g., the relative delay in parental perceptions of changes in child behavior and the low level of initial problem severity which is inherent in prevention studies. In addition to a low initial level of aggressive behavior of the child which might diminish the impact of the intervention, it might be that not all parents in a preventive sample show high levels of maladaptive parenting and that parents who show adequate parenting skills do not or only slightly modify their parenting skills due to the intervention. Even if parenting practices change, some aggressive child behavior problems might persist due to factors other than parenting, i.e., neurobiological correlates such as impairment in inhibitory control, which are more difficult to alter and as a consequence some behavior problems might continue to exist.

Although observations are generally seen as more objective measures of child behavior than parent reports, parents are the ones who have to deal with the child's aggressive behavior. Parenting interventions generally aim to increase the skills of the parents to cope with inap-

propriate child behavior (McCart et al., 2006; Webster-Stratton & Taylor, 2001). It is to be expected that parents feel equipped to deal with aggressive behavior of their child as a result of the intervention. Apparently, although parents perceived improvements in their parenting skills, this did not result in changed parental perceptions of child behavior, however, other parent characteristics might have changed. Therefore, it would be interesting to assess parental perceptions of self-confidence, stress, and emotion management skills longitudinally to investigate whether these characteristics change before parents are capable of perceiving changes in child behavior.

Screening procedures and the associated false positives were also suggested as a possible explanation for the absence of parent-rated improvements in child behavior. In order to find out whether these false positive might have actually negatively influenced the intervention effect, the children included in our sample should be followed longitudinally to assess the predictive accuracy (specifically the positive predictive value), sensitivity and specificity retrospectively (Bennett et al., 1999; Van Lier, Verhulst & Crijnen, 2003). In addition, intervention effects on parent-rated child behavior might be found in high risk groups (Foster, Jones & CPPRG, 2006). Therefore, this study must be replicated using a larger sample of children in order to investigate a subgroup of high risk children with sufficient statistical power.

Mediation of observed intervention effects on child behavior by parenting practices could not be demonstrated in our study. However, the temporal sequence of observed parent and child behavior suggested mediation: the improvements in child behavior were preceded by improvements in parenting practices. These indications of mediation give rise to further investigation of mediational processes with long term follow up data. With respect to moderation, two child factors were found to moderate intervention outcome, i.e., IQ and inhibition problems, and one parental characteristic, i.e., the level of stress. IQ was found to be a strong moderator of both observed and parent-rated child behavior. In addition, in a previous study (**Chapter 2**), we showed that inhibitory control was impaired in children with aggressive behavior as compared to typically developing children. This implies that children with the worst prognoses regarding the development of DBD due to neuropsychological or cognitive deficits, i.e., low IQ and poor inhibitory control (Maughan & Rutter, 2001; Moffitt, 1993), were found to benefit most from the intervention. Since both inhibition problems and low IQ seem to be associated with the development of aggressive behavior as well as intervention response, inhibitory control deficits and low IQ might be used as starting point for screening and development of future interventions.

At this moment, drawing conclusions on the preventive effectiveness of the IY parent program would be premature. Although we found that the presence of DBD diagnoses did not differ between the intervention and control group, the dimensional measures of child behavior are pointing in a promising direction. Parents became more skilled in dealing with their child's aggressive behavior as a result of the intervention, however, the temporal sequence of improvements in child behavior suggests that more time is needed for intervention effects on child behavior to become apparent, especially on categorical measures such as DBD diagnoses. Since treatment gains in prevention studies often become only visible after several years (Boisjoli, Vitaro, Lacourse, Barker & Tremblay, 2007; Kendall & Kessler, 2002), long term follow up is needed to see whether DBD diagnoses can be prevented, resulting in e.g., less criminality or delinquency, less school drop out and less unemployment and lower associated costs in adolescence and adulthood.

Methodological considerations

Some methodological considerations have to be made with respect to the studies presented in this thesis. First, the screening procedure we used to recruit participants consisted of only one questionnaire administered at only one moment in time, and filled out by only one informant. It might be that this screening procedure resulted in substantial misclassification and led to a high number of false positives, especially at this young age (Bennett, Lipman, Racine & Offord, 1998; Van Lier et al., 2003). At present, we do not have sufficient knowledge on the positive predictive value of risk factors associated with aggressive behavior to increase the accuracy of screening procedures. This is reflected by the large numbers of false positives in studies that employed a more extensive screening procedure (Foster et al., 2006). Multistage and multi-informant screening procedures have been suggested to decrease the risk of misclassification (Frick & Loney, 2000). However, such procedures are costly and time-consuming and whether this is outweighed by larger effect sizes due to a smaller number of false positives is not thouroughly investigated yet.

Second, since participation of parents in this study was voluntary, recruitment or motivation bias might have affected our findings. Families were selected to participate if the child scored at or above the 80th percentile on the aggressive behavior scale of the CBCL. Therefore, it would be expected that about 20% of the families would show this level of aggression. However, of all children whose parents returned the CBCL to us only 6% scored at or above the 80th percentile, indicating that our sample was biased. It might be that we were thus unable to include the most problematic families, resulting in a highly motivated, but not very problematic sample of families. This might have reduced the impact of the intervention because a low level of initial severity of aggressive behavior complicates the detection of improvements in child behavior. In addition, several invited families refused to participate in our study, e.g., because parents did not regard the aggressive behavior of their child as problematic, or because the family already received other services for their child's behavior. Since refusal rates are highest among families of children who are most at risk for future disorders (Offord, Kraemer, Kazdin, Jensen & Harrington, 1998), it would be interesting to investigate the characteristics of the families who refused to participate, either in the study or in the intervention. More information on refusal to participate could enhance our knowledge of how to engage families in interventions and might shed a light on the prerequisites of parental compliance to an intervention.

Third, the control group was a care-as-usual condition. The wide availability and relatively high quality of the care-as-usual in the Netherlands might have reduced the intervention effects. Since our study into the effectiveness of the IY parent program is part of a larger research project, the impact of the use of care-as-usual on the (cost-)effectiveness of the intervention will be addressed in a future study. In addition, currently much attention is paid to parenting practices in the media, e.g., in television programs, which might have functioned as a universal prevention program and enhanced the public awareness of the impact of parenting on child behavior. As a consequence, control group parents might have felt inclined to modify their own parenting practices, resulting in smaller differences between the intervention and control group in our evaluation of the preventive effectiveness of the IY program.

Fourth, all parents who participated in our studies were relatively highly educated, and had their first child at a relatively old age. Moreover, children were mainly of Caucasian ethnicity. This might have introduced bias to our results, because children with the most severe aggressive behavior problems often come from less educated and relatively young parents

(Côté et al., 2006; Nagin & Tremblay, 2001). In future research, efforts should be made to include parents with a low educational level, who had their first child at younger ages. Children of non-Caucasian ethnicity should also be included to enhance the generalizability of intervention effects.

Implications for clinical practice

The results reported in this thesis give rise to the use of early and accurate screening procedures to identify children at risk for DBD. Early screening is recommended because aggressive behavior patterns are more easily altered at young ages (Tremblay, 2006). Considering the deficits in inhibition shown by preschool children with aggressive behavior and the moderating influence of inhibition problems on intervention effect, screening procedures might be elaborated with measures of inhibitory control. Accurate screening procedures with a high positive predictive value, i.e., correctly identifying who might benefit most from an intervention, is required prior to the dissemination of targeted preventive interventions to reduce costs and to enhance the effectiveness (Offord et al., 1998). A child should not be identified as 'at risk' based on a single assessment (Bennett et al., 1998), but children who exhibit several factors associated with persistent aggressive behavior should be monitored over time. Children who are repeatedly classified as at risk might be considered for intervention.

With respect to parent training, the parents of these at risk children must then be motivated to participate by pointing out the potential of early intervention and the negative developmental consequences if their child remains untreated. Moreover, effective preventive interventions should be offered in easily accessible locations, e.g., community centers or youth and family centers (centra voor jeugd en gezin), and should be widely available. In a study by Barkley et al (2000) attendance rates were low due to the deliverance of the intervention in a hospital. To prevent the unintentional exclusion of parents and to ensure high attendance rates, parental participation in interventions must be facilitated. Unfortunately, to date, no accurate methods to identify high risk children in early childhood have been developed; hence the need for an optimal screening procedure remains urgent, for children with aggressive behavior who might benefit from these programs should be involved in intervention from a young age onwards.

Recommendations for future research

Several recommendations for future research have been mentioned previously, based on limitations or findings from the studies presented in this thesis. However, it must be emphasized that long term follow up is needed to investigate whether the IY parent program actually prevented the development of DBD. Moreover, the cost-effectiveness of this preventive program has to be examined to see whether the effects of the intervention outweigh the costs of such a comprehensive program. Considering the high costs of a chronic pattern of antisocial behavior, cost-effectiveness will probably be demonstrated if the IY parent program succeeds in averting DBD. Even if the intervention only demonstrates preventive effects in a group of high risk children, the intervention might still be cost-effective (see e.g., Foster et al., 2006). Therefore, it would be interesting to replicate this study with a larger sample of children to investigate a subgroup of high risk children with sufficient statistical power. In addition, the clinical significance of the intervention has to be assessed by comparing the intervention and control group to a group of typically developing peers (Boisjoli et al., 2007).

In future prevention studies, similar to medicine trials, objective outcome measures should be chosen in advance of the study to establish the preventive effectiveness of an intervention (Kraemer, Wilson, Fairburn & Agras, 2002). This might control for bias of expectations of intervention effects of both researchers and parents. Several informants, e.g., parents and teachers, and at least one measure with objective criteria should be used (Scott, 2001). Based on the findings presented in Chapter 5, the use of observation as an objective outcome measure is recommended, especially in prevention studies. Observational measures are not distorted by parental perceptions of child behavior and have proven to be sensitive to changes as a result of the intervention (Brotman et al., 2008; Webster-Stratton, 1998; Chapter 5). The high costs incurred by sufficient observations to obtain valid and reliable data might be outweighed by the benefits and savings yielded by effective prevention programs.

Mediation and moderation should be further explored in future studies to identify how this preventive intervention works and to whom it is most beneficial. The promising results of the IY parent program found in this population-based study and the difference between research settings and clinical practice also give rise to dissemination studies in clinical practice, provided that the positive predictive accuracy of screening procedures is increased. Implementation of the program should be closely monitored to ensure treatment fidelity and thus intervention effect in real-life settings.

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Nederlandse samenvatting
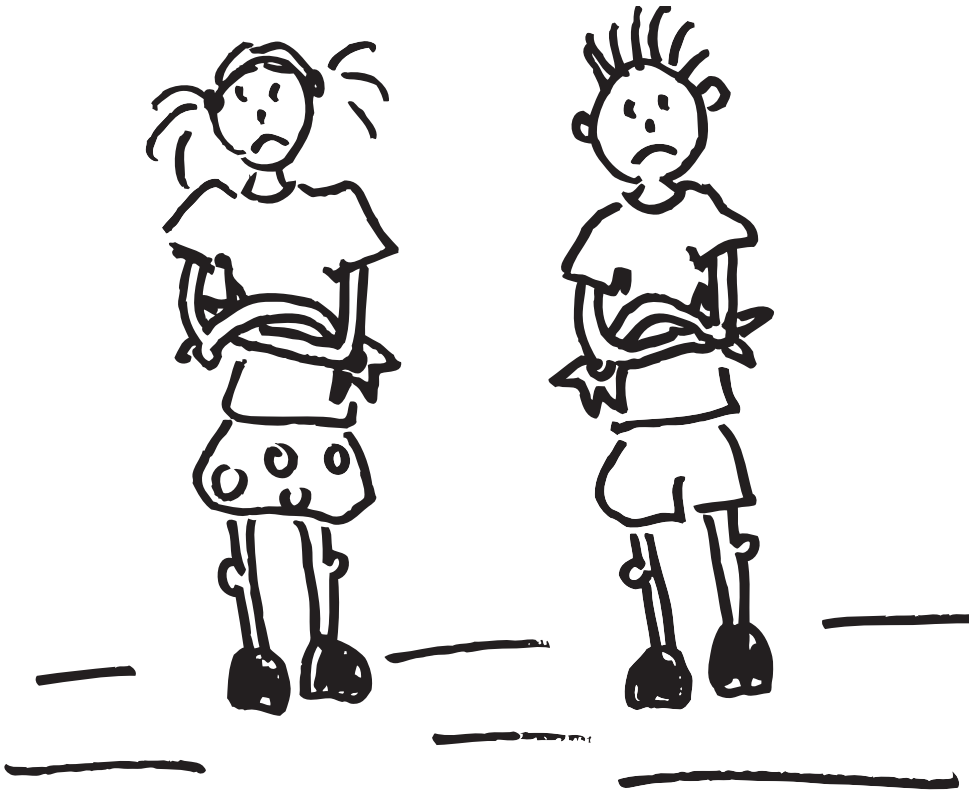
Nederlandse Samenvatting

Agressief gedrag is een veelvoorkomend fenomeen bij jonge kinderen. In de peuterleeftijd bereikt het niveau van agressie een hoogtepunt, om vervolgens gestaag, maar continue af te nemen. Er zijn echter kinderen bij wie een hoog niveau van agressief gedrag ook in de kleutertijd nog aanwezig is. Onderzoek naar de ontwikkeling en het beloop van agressie wijst uit dat kinderen die een chronisch en persistent hoog niveau van agressief gedrag laten zien een verhoogde kans hebben op het ontwikkelen van disruptieve gedragsstoornissen. Een persistent patroon van agressief gedrag of een disruptieve gedragsstoornis brengt veel nadelige gevolgen met zich mee, zoals slechte schoolprestaties en sociale isolatie in de kinderleeftijd, en werkeloosheid, middelengebruik, relatieproblemen of criminele activiteiten in de volwassenheid. Deze nadelige gevolgen en daarbij behorende hoge kosten maken dat chronisch agressief gedrag een negatief effect heeft op zowel de ontwikkeling van het kind, als het gezin en de maatschappij. Om deze negatieve gevolgen af te wenden, moet een dergelijk patroon van agressief gedrag zo vroeg mogelijk doorbroken worden.

Verschillende factoren worden geassocieerd met het ontstaan en in stand blijven van agressief gedrag. Dit zijn individuele factoren, bijvoorbeeld temperament, neuropsychologisch functioneren of tekorten in inhibitie en sociale informatie verwerking, maar ook omgevingsfactoren, zoals contact met leeftijdgenoten, het gezin en de opvoeding. Bij de behandeling van agressieve gedragsproblemen wordt op deze factoren ingespeeld. Van de verschillende behandelingen die voor disruptief gedrag voor handen zijn, is oudertraining in opvoedingsvaardigheden het meest effectief gebleken in het reduceren van agressie bij jonge kinderen. Vanaf de jaren zestig zijn er diverse programma's ontwikkeld die beogen agressief gedrag van het kind te doen afnemen door de opvoedingsvaardigheden van de ouders te vergroten. Een ouderprogramma waar veel onderzoek naar gedaan is en dat effectief is gebleken als behandeling voor agressieve gedragsproblemen is de Incredible Years oudertraining.

Of de Incredible Years oudertraining ook effectief is als preventieve methode is echter nog niet onomstotelijk bewezen. De resultaten van diverse studies uit het buitenland laten zien dat het oudergedrag in ieder geval verbetert als gevolg van deze training. Met betrekking tot de verbetering van kindgedrag zijn de resultaten van deze studies minder eenduidig: sommige studies beschrijven verbetering van zowel door onderzoekers geobserveerd kindgedrag als door ouders gerapporteerd kindgedrag, andere vinden alleen een verbetering van het door onderzoekers geobserveerde kindgedrag, of er wordt vooral verbetering gezien bij de groep kinderen die het meeste risico loopt op het ontwikkelen van agressieve gedragsstoornissen.

Gezien de nadelige gevolgen van chronisch agressief gedrag en de hoge kosten die dit met zich mee brengt, is er behoefte aan onderzoek naar factoren die betrokken zijn bij het ontstaan en in stand houden van agressief gedrag bij jonge kinderen en naar het effect van preventieve interventies. Het doel van dit proefschrift is dan ook het onderzoeken van neuropsychologische factoren, de belasting van het gezin en de kosten van hulpverlening bij kinderen die al op jonge leeftijd een hoog niveau van agressief gedrag vertonen, alsmede het onderzoeken van het preventieve effect van de Incredible Years oudertraining op 4-jarige kinderen die risico lopen op het ontwikkelen van disruptieve gedragsstoornissen.

In **hoofdstuk 2** wordt de studie naar het neuropsychologisch functioneren, ofwel executieve functies, van kleuters met agressief gedrag beschreven. Uit onderzoek komt naar voren dat met name kinderen met ADHD tekorten in hun executieve functies laten zien; over de vraag of dit ook het geval is bij kinderen met agressief gedrag wordt getwist. We hebben het neuropsychologisch functioneren van 82 vierjarige kinderen met agressief gedrag vergeleken met het neuropsychologisch functioneren van 99 kinderen die zich gunstig ontwikkelen. Zes verschillende executieve functie taken zijn afgenomen om werkgeheugen, cognitieve flexibiliteit, woordvloeiendheid en inhibitievermogen te meten. Het meten van executieve functies bij jonge kinderen wordt bemoeilijkt doordat er weinig passende meetinstrumenten voor deze leeftijdsgroep zijn en er geen eenduidigheid bestaat over welke executieve functies er op deze leeftijd al te onderscheiden zijn. Om deze redenen is er met de scores op de verschillende neuropsychologische taken een factoranalyse gedaan, waaruit alleen inhibitie als afzonderlijke factor gedestilleerd kon worden. De agressieve kinderen lieten tekorten in inhibitie zien wanneer zij vergeleken werden met de controlegroep en ook wanneer aandachtsproblemen gecontroleerd werden, bleef dit effect bestaan. Meisjes presteerden op alle executieve functie taken beter dan jongens. Uit deze studie komt naar voren dat inhibitie een executieve functie is die al op jonge leeftijd te onderscheiden is en ook al op jonge leeftijd samenhangt met agressief gedrag.

In **hoofdstuk 3** wordt onderzocht of de belasting van het gezin en de kosten van hulpverlening aan jonge kinderen die veel agressief gedrag laten zien verschillen van de gezinsbelasting en kosten van hulpverlening aan kinderen waarbij weinig agressief gedrag voorkomt. In eerder onderzoek bij kinderen in de schoolleeftijd is gevonden dat de kosten van hulpverlening aan kinderen met agressief gedrag hoger liggen dan de kosten van kinderen die zich gunstig ontwikkelen. Ook de belasting van het gezin is groter gebleken bij kinderen met agressief gedrag dan bij kinderen die weinig gedragsproblemen vertonen. Ouders functioneren bijvoorbeeld minder optimaal op hun werk, moeten vaker hulp inschakelen bij het doen van huishoudelijke taken, of krijgen zelf psychische of lichamelijke klachten als gevolg van de problemen van hun kind. In deze studie hebben we 317 vierjarige kinderen verdeeld over vier groepen: kinderen met een laag, gemiddeld, hoog-gemiddeld en een hoog niveau van agressie. Vervolgens hebben we deze groepen met elkaar vergeleken wat betreft de kosten van hulpverlening en gezinsbelasting. Gezinnen van kinderen met een hoog-gemiddeld of hoog niveau van agressie gaven aan meer gehinderd te worden in hun dagelijks functioneren en dus een grotere belasting van het gezin te ervaren dan gezinnen van kinderen met lagere niveaus van agressief gedrag. Ook kwam uit de resultaten naar voren dat kinderen met een hoog niveau van agressie significant meer kosten met zich mee brachten als gevolg van meer hulpverleningsconsumptie dan kinderen met een laag niveau van agressief gedrag. Deze bevindingen hebben gevolgen voor bijvoorbeeld de leeftijd waarop interventies ingezet zouden moeten worden om tot grote besparingen te leiden door het vroeg voorkomen van agressief gedrag.

In **hoofdstuk 4** wordt de methodologische kant van de studie naar het effect van het Incredible Years ouderprogramma beschreven. Over het algemeen worden gerandomiseerde onderzoeksdesigns gezien als de meest optimale manier om de effectiviteit van interventies te meten. Door proefpersonen bij toeval aan de interventie- of controlegroep toe te kennen, worden de verschillen tussen deze groepen in latente variabelen zo klein mogelijk gehouden. De effecten die vervolgens gevonden worden, kunnen dan toegeschreven worden aan de interventie en zijn niet het gevolg van mogelijke andere factoren. In de praktijk blijkt het

echter niet altijd haalbaar om een gerandomiseerd onderzoeksdesign te gebruiken vanwege praktische of ethische belemmeringen. Om deze reden zijn er alternatieve onderzoeks-designs ontworpen, zoals quasi-experimentele designs. Gezien de onhaalbaarheid van een gerandomiseerd design in onze studie naar het preventieve effect van de Incredible Years oudertraining als gevolg van geografische en motivationele beperkingen, is ervoor gekozen een 'case control' design te gebruiken. Om dit niet-gerandomiseerde design te vergelijken met een gerandomiseerd design zijn de interventie- en controlegroep gesimuleerd op basis van de data uit de effect-studie. De interventie- en controlegroep werden gematcht op zes karakteristieken die het interventie-effect zouden kunnen beïnvloeden: sekse, IQ en het niveau van agressief gedrag van het kind, en het opleidingsniveau en het niveau van stress van de ouders en de urbanisatiegraad van de woonplaats van het gezin. De balans van de zes karakteristieken tussen de interventie- en controlegroep in het ongerandomiseerde 'case control' design werd vergeleken met de balans van karakteristieken tussen de groepen in het gerandomiseerde design. Hieruit kwam naar voren dat het matchen van gezinnen in het 'case control' design in 34% van de gevallen, met een maximum van 50%, tot een betere verdeling van de karakteristieken had geleid dan het gerandomiseerde design. Dit houdt in dat het gebruik van een 'case control' design met gematchte groepen een acceptabel en uitvoerbaar alternatief is wanneer een gerandomiseerd design om praktische redenen niet haalbaar is. In toekomstig onderzoek moet meer gekeken worden naar de methodologische kwaliteit van onderzoeksdesigns om het begrip van de gevolgen van niet-gerandomiseerde designs te vergroten.

In **hoofdstuk 5** wordt het onderzoek naar de preventieve effectiviteit van het Incredible Years ouderprogramma beschreven. Inadequate opvoedingsvaardigheden van ouders vor-men een belangrijke factor bij het ontstaan en de instandhouding van agressief kindgedrag op jonge leeftijd. Het is dan ook niet verrassend dat ouderprogramma's gericht op het vergroten van adequate opvoedingsstrategieën effectief zijn gebleken in het reduceren van agressief gedrag bij jonge kinderen. Uit studies naar de effectiviteit van behandelingen voor kinderen met agressief gedrag komt de Incredible Years oudertraining naar voren als één van de meest effectieve programma's. De preventieve effectiviteit van dit programma is echter minder vaak onderzocht en de resultaten van deze studies geven geen eenduidig beeld van het preventieve effect. In dit hoofdstuk wordt de preventieve effectiviteit van het Incre-dible Years ouderprogramma onderzocht bij kleuters die risico lopen op het ontwikkelen van disruptieve gedragsstoornissen. De interventiegroep bestaande uit 72 kinderen werd individueel gematcht (zie hoofdstuk 4) aan 72 kinderen in de controlegroep. Er werd een observatie gedaan waarbij de ouder met het kind speelde en er werden vragenlijsten en in-terviews afgenomen bij de ouders en leerkrachten van deze kinderen op drie verschillende meetmomenten: voor de interventie, direct na de interventie en een jaar na de interventie. De resultaten van deze studies laten zien dat zowel geobserveerde als door de ouders gerapporteerde opvoedingsvaardigheden verbeterd zijn na het volgen van de interventie. Deze verbetering bleef ook bestaan bij de meting een jaar na de interventie. Ook werden er verbeteringen in geobserveerd kindgedrag zichtbaar naarmate de tijd verstreek. Ouders en leerkrachten gaven echter geen verbetering in kindgedrag aan en een jaar na de interventie verschilden de interventie- en controlegroep niet van elkaar wat betreft het voorkomen van diagnosen van disruptieve gedragsstoornissen. In deze studie kon niet worden aangetoond dat de effecten op geobserveerd kindgedrag gemedieerd werden door de verandering in opvoedingsvaardigheden. De gevonden interventie-effecten werden gemodereerd door het

stressniveau van de ouders en door IQ en tekorten in inhibitie van het kind; het effect van de interventie was het grootst voor ouders met een hoog niveau van stress en kinderen met een laag IQ of veel tekorten in inhibitie.

Samenvattend kan gesteld worden dat deze studie het veelbelovende karakter van het Incredible Years ouderprogramma ondersteunt, wat te zien is aan de blijvende verbetering in geobserveerd kindgedrag. Dat ouders de verbetering niet waarnemen kan liggen aan het lage niveau van agressie dat de kinderen bij aanvang van de interventie vertoonden of aan het feit dat ouderlijke waarneming minder snel verandert dan kindgedrag als gevolg van duurzame cognities die ouders hebben over hun kind. Ook de screeningsmethode en de waarschijnlijkheid van een groot aantal vals positieven kan het interventie-effect negatief beïnvloed hebben. Om er achter te komen of dit werkelijk het geval was, zullen deze kinderen longitudinaal gevolgd moeten worden en moet de positieve voorspellende waarde van de screeningsprocedure zoals die hier gebruikt is bekeken worden.

In **hoofdstuk 6** worden de resultaten van de bovenstaande studies besproken. Aangezien we verschillen in inhibitievermogen vonden tussen jonge kinderen met en zonder agressief gedrag, zouden tekorten in inhibitie een aanknopingspunt kunnen vormen bij de screening van jonge kinderen die risico lopen op het ontwikkelen van agressief gedrag. De studie naar de kosten van hulpverlening en de gezinsbelasting in gezinnen van jonge kinderen met agressief gedrag benadrukt het belang van het zoeken en ontvangen van hulpverlening voor dergelijk gedrag en onderstreept het belang van preventie. Passende hulp kan de belasting voor het gezin aanzienlijk verlagen en preventieve interventies die al op jonge leeftijd ingezet worden, zouden op langere termijn tot grote besparingen kunnen leiden.

In onderzoek naar de effectiviteit van interventies wordt waar mogelijk gebruik gemaakt van gerandomiseerde designs. Wanneer dit echter niet mogelijk is, kan een case control design met gematchte groepen als alternatief gezien worden. Het is dan wel van belang om de methodologische kwaliteit van het onderzoeksdesign in kaart te brengen. In ons onderzoek naar de preventieve effectiviteit van de Incredible Years oudertraining vonden we verbeteringen in opvoedingsvaardigheden en in geobserveerd kindgedrag. Longitudinaal onderzoek is vereist om te kijken of deze interventie werkelijk een preventief effect heeft. Het zou zo kunnen zijn dat er na verloop van tijd nieuwe effecten zichtbaar worden. Ook de kosteneffectiviteit van dit programma moet onderzocht worden om na te gaan of de verbeteringen als gevolg van deze interventie opwegen tegen de kosten en leiden tot kostenbesparingen.

Verdere aanbevelingen voor toekomstig onderzoek die gedaan worden zijn het vooraf vaststellen van primaire objectieve uitkomstmaten in effectiviteitsonderzoek en het gebruik van observaties in preventief onderzoek. Ook wordt aangeraden om mediatie en moderatie verder te bekijken en eventueel implementatiestudies te starten, mits de screening van kinderen die risico lopen op het ontwikkelen van disruptieve gedragsstoornissen verbeterd wordt.

Dankwoord
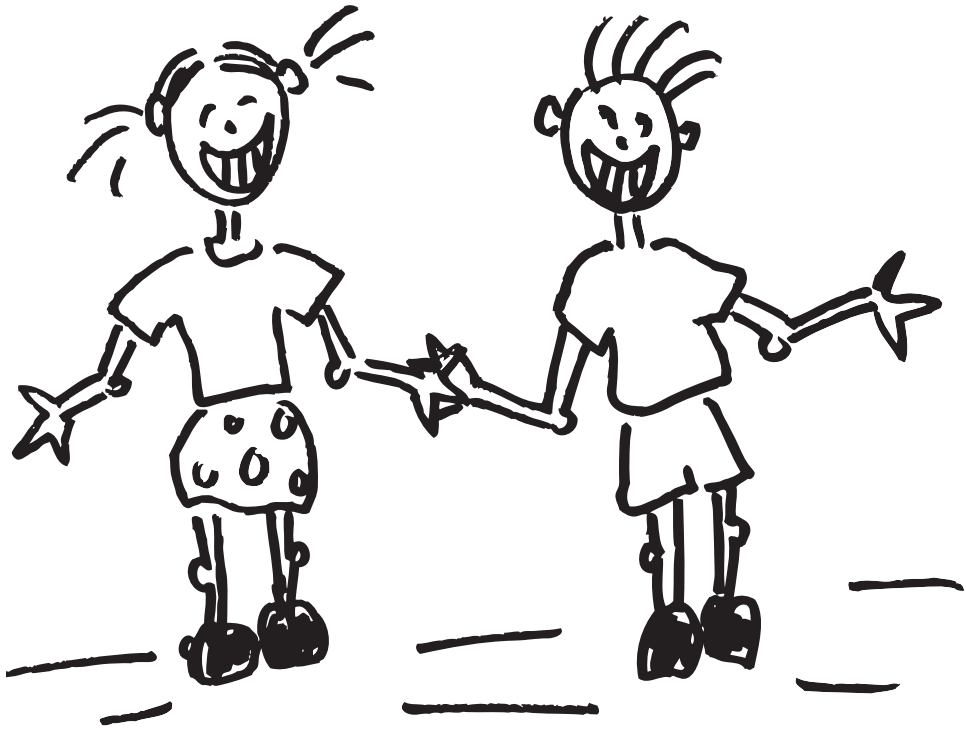
Dankwoord

Tijdens het sollicitatiegesprek voor de aio-positie waarvan dit proefschrift het resultaat is, werd mij gevraagd of ik me wel realiseerde dat promoveren een periode van eenzaamheid en ascese is. Gelukkig bleek in de afgelopen vijf jaar niets minder waar te zijn en graag wil ik op deze plaats dan ook iedereen te bedanken die op welke manier dan ook betrokken is geweest bij de totstandkoming van dit onderzoek.

Ten eerste zijn er de ouders en kinderen die hun medewerking verleend hebben. Ouders, bedankt dat jullie tijd gemaakt hebben om meerdere malen onze boekwerken met vragenlijsten in te vullen en dat wij bij jullie thuis mochten komen. Kinderen, bedankt voor de tijd dat we jullie mochten filmen of taakjes met jullie konden doen. Dankzij jullie is dit onderzoek geslaagd! In het bijzonder wil ik de ouders bedanken die deelgenomen hebben aan de oudergroepen (met name de groepen die ik zelf gegeven heb op MKD De Molenhorst en in Nieuwegein); hartelijk dank voor jullie komst en enthousiaste inbreng voor een periode van 18 of zelfs 22 weken!

Dan is er de man die mijn interesse voor de wetenschap heeft gewekt. Quinten Raaijmakers (nee, geen familie), bedankt voor het aanzwengelen van mijn academische carrière. Zonder jouw eerste aanzet was ik nooit als aio aan de slag gegaan, laat staan opnieuw bij de UU terecht gekomen. Dank voor het vertrouwen in mijn onderzoekscapaciteiten.

Mijn promotoren, Walter en Herman, wil ik bedanken voor de mogelijkheid om dit project uit te voeren en tot een goed einde te brengen. Walter, dank voor je begeleiding bij mijn promotietraject. Het was fijn dat je altijd op korte termijn tijd had voor overleg over de meest uiteenlopende zaken, van het inkorten van mijn zeer uitgebreide teksten tot 'personeelszaken'. Veel waardering heb ik voor je kritische blik en snelle feedback op stukken, en vooral voor je enorme kennis van gedragsstoornissen. Bedankt voor het vertrouwen dat je mij hebt gegeven. Herman, dank voor het verbreden van mijn blikveld en je heldere kijk op zowel de wetenschap als de klinische praktijk. Bij het bespreken van artikelen had jij altijd nog wel een handige referentie paraat om net even iets extra's aan het stuk toe te voegen. Bedankt voor het delen van je inzicht.

En dan is er natuurlijk het team waarmee we dit project gestart zijn; Walter, Marte, Nienke, Karlijn en Jocelyne. Met z'n zessen naar Seattle en Manchester om getraind te worden of supervisie te krijgen over de Incredible Years cursus en kennis te maken met het gedachtegoed van Carolyn. Wat hebben we veel gelachen (van "hi Ashley" tot "er ligt een struik op mijn bord" of "mmm, nice salad"). Het was fijn om met jullie samen te werken, ervaringen te delen en van jullie te leren. Marte, samen met jou heb ik mijn eerste stappen hier in het UMC gezet. Dank voor al het vertaalwerk, groepen draaien en je enthousiasme. Ik vond het fijn om met je samen te werken en te ontdekken hoe het ouderprogramma precies in elkaar stak. Nienke, dank voor het groepen draaien, voor de vele telefoontjes naar o.a. ouders en locaties, en het onderhouden van het contact met onze financiële man. Karlijn, dank voor je betrokken houding naar zowel het project als mij persoonlijk toe, het draaien van groepen en het beoordelen van mijn eerste WPPSI!

Dit onderzoek zou ook zeker niet uitgevoerd zijn zonder de hulp van vele stagiaires (Monique en Cathy, hartelijk dank voor de werving en begeleiding van deze dames); Ilona, Floor, Cécile, Miriam, Mariëlle, Marieke, Jeannette, José, Sarah, Eveline, Marlies, Hannelieke, Cinthia, Diana, Lonneke, Marion, Marlous, Marilou, Mieke, Ineke, Liv, Anouk, Froukje, Elske, Ineke, Laura, Ryanne en Yvonne, hartelijk dank voor jullie grote inzet en de bergen werk die jullie verzet hebben. Sommigen van jullie zijn na de stage nog even bij ons gebleven als research-assistent; José, Cinthia, Hannelieke en Froukje, bedankt voor het overbrengen van jullie ervaringen op de volgende stagiaires en voor het enthousiasme waarmee jullie doorgewerkt hebben. Ook de andere research-assistenten hartelijk bedankt voor het meewerken aan dit onderzoek. Renske, je hebt in een korte, maar belangrijke periode het project draaiende gehouden door veel huisbezoeken te doen, dank daarvoor. Marieke, wat was jij snel ingewerkt en het was fijn om te weten dat de planning en logistiek bij jou in goede handen waren.

I would also like to thank Carolyn Webster-Stratton for her support of our research project and her trust in our team in delivering the Incredible Years training with fidelity in the Netherlands. Caroline White, thank you for your supervision and the peer coach training. I have learned so much about parent training from both of you and I am looking forward to becoming an Incredible Years mentor!

Gerard, hartelijk dank voor jouw statistische bijdrage aan dit proefschrift. Jouw scherpe oog voor statistische details en de Engelse taal heeft ervoor gezorgd dat bij verschillende hoofdstukken nog net even de puntjes op de 'i' werden gezet.

Ben, bedankt voor het meedenken over de kosten-analyses; na overleg met jou zat ik altijd weer vol nieuwe ideeën. Ook wil ik je bedanken voor je uitleg en geduld bij de analyses in R. Rianne, Marie-José en Iris, jullie wil ik bedanken voor het opstellen van de vragenlijst over werk en kosten, verschillende statistische analyses en het achterhalen van de kosten van hulpverlening. Erik, de Excel- en inmiddels ook matchings-expert, wat een genot om met jou samen een artikel te schrijven. Van jou heb ik geleerd dat gewoon beginnen met schrijven en later bijschaven helemaal niet zo'n gekke strategie is om een artikel te schrijven. Dank voor je geduld met mij en voor alle berekeningen.

Diana, dank voor het gebruik van jouw neuropsychologische testbatterij en alle uitleg daarbij. Ook fijn dat je zelfs vanuit Australië nog feedback hebt gegeven op het artikel. Joe, ook jij bedankt voor het meedenken en je advies over het executieve functie-artikel.

Betere Start, oftewel Myriam, Ankie, Jocelyne, Bram en Froukje, wat was het fijn om een project naast het afronden van mijn proefschrift te hebben en met jullie na te denken over meer praktische zaken. Dank voor de afleiding. Myriam, ik vond het ontzettend leuk om met jou de cursus te geven; dank voor je openheid, je feedback en voor alles wat je me geleerd hebt over de omgang met deze bijzondere doelgroep.

Mede-aio's, Myriam, Maurice, Mirjam, Mariëlle, Tim, Martijn, Hilde, Jocelyne, Kim, Imke, Patrick, Janna, Marieke, Heval, Selene, Jolijn en alle andere onderzoekers van het UMC die ik in de afgelopen 5 jaar heb leren kennen (Irene, Maretha, Claudine), dank voor de leuke borrels en uitjes, het uitwisselen van tips en adviezen en de feedback op presentaties.

Roomies, Jocelyne, Renske, Froukje, Kim en Sarah, na vele verhuizingen binnen het ziekenhuis en diverse wisselingen van kamergenoten heb ik bij jullie mijn laatste periode op het UMC doorgebracht. Dank voor jullie interesse in mijn wel en wee, de thee en koffie (met opgeschuimde melk uiteraard), drop, borrels, etentjes en vooral voor jullie gezelligheid!

En dan zijn er nog wat mensen in de privé-sfeer die ik wil bedanken omdat ze mij op welke manier dan ook bijgestaan hebben in de afgelopen vijf jaar: de dames van Sherazade (dank voor jullie interesse en gezelligheid; reuzeleuk dat jullie in groten getale mee zijn gegaan op lustrumreis), Hiske, Mieke, Saskia, Danny & Jolanda (of moet ik jaarclub zeggen; dank voor jullie belangstelling en de fijne etentjes), Stichting (altijd geslaagde drinkgelagen afgewisseld met serieuzere zaken; is onze ontbinding nu echt een feit?); en ook alle andere vrienden, vriendinnen en familie hartelijk bedankt voor jullie luisterend oor en enthousiaste verhalen!

Naomi, dank voor de leuke illustraties voor in en op dit proefschrift. Jeroen, bedankt voor het tot één geheel smeden van dit boekje en de mooie vormgeving.

Liefste vriendinnetjes, Naomi, Anneloes en Jolanda, altijd fijn om bij jullie stoom af te kunnen blazen, samen paaseieren te gieten, te mountainbiken, te dansen, of gewoon lekker bij te kletsen tijdens een etentje of weekendje weg. Wat is het heerlijk om jullie al zo lang te kennen; dank voor jullie onvoorwaardelijke acceptatie en vriendschap!

Lieve paranimfen, lieve Jolanda en Jocelyne, wat fijn dat jullie deze dag niet alleen figuurlijk maar ook letterlijk achter mij staan! Lieve Jo, je bent al meerdere keren genoemd in dit dankwoord en dat is niet voor niets. Het is altijd fijn om met jou van gedachten te wisselen over behandelingen (voor welke doelgroep dan ook), gezinnen (ook die van ons zelf) en ik vond het super om jou als clinicus aan het werk te zien, maar ik kan ook genieten van je 'gekke' buien (hoewel ik inmiddels hoop dat je nu zelf ook inziet dat je noch gek, noch autistisch bent!). En nu is het tijd voor de volgende 'stappen' in onze levens; ik voel me vereerd dat ik straks jouw getuige mag zijn! Dank voor je vertrouwen en steun en ik kijk uit naar onze verdere vriendschap!

Lieve Josh, ook jij bent al eerder in dit stuk voorgekomen en wat was het een feest om met jou aio te zijn! Voordat ik begon was er al voorspeld dat jij een goede collega voor mij zou zijn, en dat ben je zeker geweest. Samen over onderzoeksvraagstukken gebogen zitten, zowel data als persoonlijkheden analyseren, naar Friesland, Bergen of Seattle, stagiaires aannemen en beoordelen, theeën, groepen draaien, verhuizen, de stad in (om te winkelen of te dansen), lang samen in de auto zitten (jij rijdt heen en ik natuurlijk terug) en veel kletsen en lachen; alles kon en mocht, waarvoor dank! Ik heb genoten van je humor, je enthousiasme en heb veel respect voor je enorme werklust. Je bent een top-onderzoeker, maar zeker ook klinisch sterk, en ik verheug me er nu al op om jouw proefschrift te lezen! Ik hoop dat onze samenwerking en contact nog lang voort zullen duren.

Lieve pap en mam, dank voor jullie steun, aandacht en onvoorwaardelijke vertrouwen in mij! Het is fijn om te weten dat jullie er altijd voor mij zijn. Ook al neem ik de telefoon niet altijd meteen op, jullie interesse in mijn leven wordt zeker wel gewaardeerd! Lieve Erik en Ria, bedankt voor jullie interesse in mijn onderzoek. Broer, ik hoop dat je de samenvatting van mijn proefschrift hebt gelezen ondanks het 'jargon'. Leuk om te merken dat we van twee

kinderen die kibbelen om wie het konijn vast mag houden veranderd zijn in (jong)volwassenen met soms vergelijkbare dilemma's; dank voor je advies! Jan en Marianne, hartelijk dank voor jullie belangstelling in mij, alle hulp bij klussen en verhuizen en voor het bijdragen aan de broodnodige ontspanning door ons bijvoorbeeld meermaals jullie tent te lenen.

Lief, lieve Jaring, wat moet het voor jou afzien geweest zijn als je weer moest luisteren naar een verhaal over agressieve kinderen, gedetineerde moeders of andere onderzoeksperikelen. Mijn soms niet al te heldere uitleg zal niet altijd even makkelijk voor jou te verteren zijn geweest. Maar wat ben ik blij dat jij er voor mij was (en nog steeds bent!) om tegen te praten, mee na te denken en bij thuis te komen. Ook ben ik je veel dank verschuldigd voor het overnemen van sommige 'taakjes' in de periode dat ik dit stuk aan het schrijven was, met als onbetwist hoogtepunt het naai-atelier in Arnhem. Wat kan mij in godsnaam gebeuren met een man zoals jij aan mijn zij? Op naar een fijne en gelukkige toekomst samen!

Curriculum Vitae
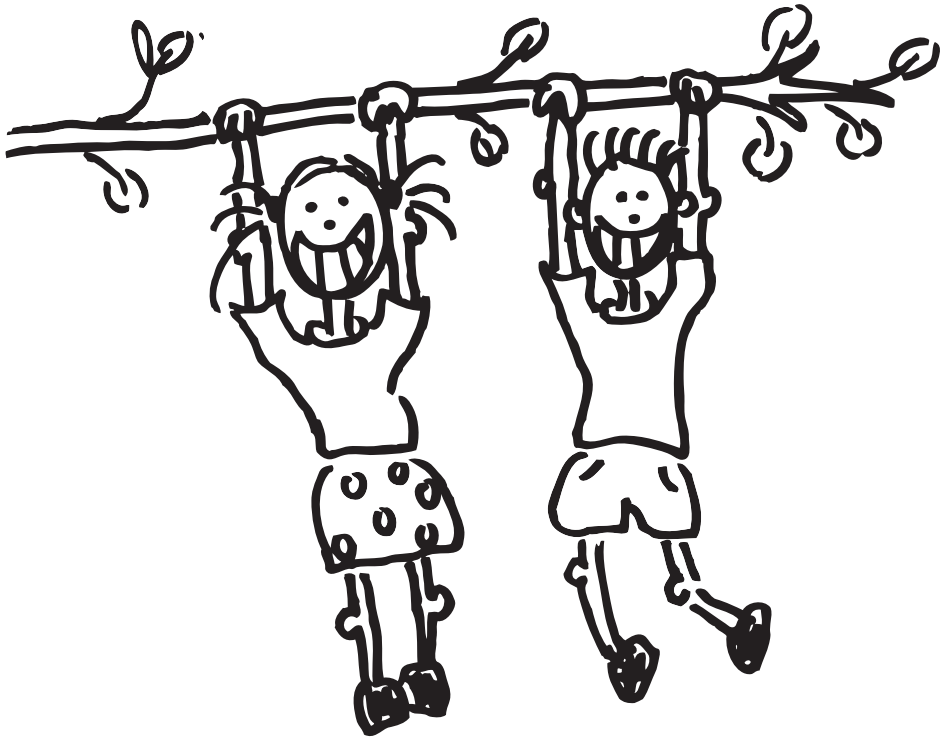
Curriculum Vitae

Maartje Raaijmakers werd geboren op 30 oktober 1981 in Heerhugowaard. In 1999 behaalde zij haar VWO diploma aan het Kalsbeek College te Woerden. Daarna begon zij met de studie Pedagogische Wetenschappen aan de Universiteit Utrecht. Haar stage hiervoor deed zij op Vosseveld, een kinderpsychiatrische behandelkliniek voor kinderen met gedragsstoornissen. Voor haar afstudeeronderzoek bekeek zij de morele ontwikkeling van kinderen met internaliserende en externaliserende problemen. In 2003 behaalde zij het doctoraaldiploma van deze opleiding. Aansluitend startte zij in september 2003 met haar promotieonderzoek op de afdeling kinder- en jeugdpsychiatrie in het UMC Utrecht, waarvan de resultaten in dit proefschrift werden beschreven. Tijdens haar promotietraject, in 2005, werd zij gecertificeerd als 'group leader' in het Incredible Years ouderprogramma en sinds 2008 is zij in opleiding tot mentor in dit zelfde programma. In februari 2008 behaalde zij haar NVO diagnostiek aantekening naar aanleiding van de diagnostiek behorende bij haar promotieonderzoek. Vanaf mei 2007 was zij tevens werkzaam bij het project 'Betere Start' van de sectie Ontwikkelingspsychologie van de Universiteit Utrecht. In het kader van dit project geeft zij het Incredible Years ouderprogramma aan (ex-)gedetineerde moeders.

Appendices
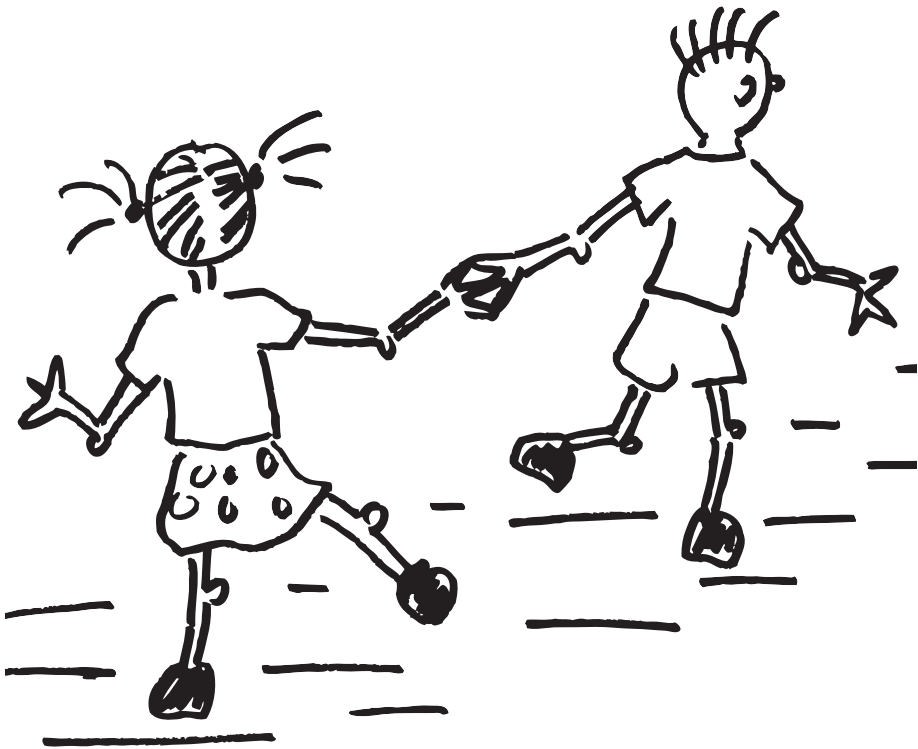
Appendix A

DSM-IV-TR (APA, 2000) Diagnostic Criteria for Oppositional Defiant Disorder

A. A pattern of negativistic, hostile, and defiant behavior lasting at least 6 months, during which four (or more) of the following are present:

-       Often loses temper
-       Often argues with adults
-       Often actively defies or refuses to comply with adults' requests or rules
-       Often deliberately annoys people
-       Often blames others for his or her mistakes or misbehavior
-       Is often touchy or easily annoyed by others
-       Is often angry and resentful
-       Is often spiteful or vindictive

Note: Consider a criterion met only if the behavior occurs more frequently than is typically observed in individuals of comparable age and developmental level.

B.   The disturbance in behavior causes clinically significant impairment in social, academic, or occupational functioning.

C.   The behaviors do not occur exclusively during the course of a Psychotic or Mood Disorder.

D.   Criteria are not met for Conduct Disorder, and, if the individual is age 18 years or older, criteria are not met for Antisocial Personality Disorder.

Appendix B

DSM-IV-TR (APA, 2000) Diagnostic Criteria for Conduct Disorder

A. A repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated, as manifested by the presence of three (or more) of the following criteria in the past 12 months, with at least one criterion present in the past 6 months:

Aggression to people and animals
- Often bullies, threatens, or intimidates others
- Often initiates physical fights
- Has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, a broken bottle, knife, gun)
- Has been physical cruel to people
- Has been physical cruel to animals
- Has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery)
- Has forced someone into sexual activity

Destruction of property
- Has deliberately engaged in fire setting with the intention of causing serious damage
- Has deliberately destroyed others' property (other than by fire-setting)

Deceitfulness or theft
- Has broken into someone else's house, building, or car
- Often lies to obtain goods or favors or to avoid obligations (i.e., "cons" others)
- Has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)

Serious violations of rules
- Often stays out at night despite parental prohibitions, beginning before age 13 years
- Has run away from home overnight at least twice while living in parental of parental surrogate home (or once without returning for a lengthy period)
- Is often truant from school, beginning before age 13 years

B. The disturbance in behavior causes clinically significant impairment in social, academic, or occupational functioning.

C. If the individual is age 18 years or older, criteria are not met for Antisocial Personality Disorder.

Code based on age at onset:
Conduct Disorder, Childhood-Onset Type: onset of at least one criterion characteristic of Conduct Disorder prior to age 10 years
Conduct Disorder, Adolescent-Onset Type: absence of any criteria characteristic of Conduct Disorder prior to age 10 years
Conduct Disorder, Unspecified Onset: age at onset is not known

Specify Severity:
Mild: Few if any conduct problems in excess of those required to make the diagnosis, **and** conduct problems cause only minor harm to others.
Moderate: Number of conduct problems and effect on others intermediate between "mild" and "severe"
Severe: Many conduct problems in excess of those required to make the diagnosis, **or** conduct problems cause considerable harm to others.

Appendix C

Questionnaire on Work and Costs (Julius Center, UMC Utrecht, 2003/2004)

This questionnaire asks about the consequences of the potential behavior problems of your child you might have experienced at work (this includes not only employment, but also voluntary work and household tasks). For example, it could that you had to take a day off from work, or that you were not able to function optimal at work, or that you were not able to carry out tasks at all, due to the potential behavior problems of your child. In addition, it could also be that you were absent at work because you had to visit a general practitioner, a social worker or a psychologist.

The behavior problems of your child might not only constitute an emotional burden, but might also have financial consequences with respect to your wages (because of not being able to work as much as you wish) as well as with respect to the extra expenses for example due to service use. This questionnaire is aimed at gaining insight in these financial consequences.

There are no 'correct' or 'incorrect' answers. We want to know your personal opinion.

Filled out by: mother / father (please circle your answer)

Please think of your situation in **the past three months.**
1.   Do you currently hold a paid job?
O   Yes, I am currently working ……. hours a week, divided over ……..days.
         My position is: …………………………………………………………..
O   No

If you currently have a paid job, please continue with questions 2 to 6.
If you do not have a paid job, continue with question 7.

Questions about your paid job
It could be that you were absent from work due to the behavior problems of your child, because you had to spent a day at home or because you had to visit services. It could also be that you did go to work, but you were not able to function optimally due to the behavior problems of your child. This is the subject of questions 3 to 11.

2a.   How many days have you been absent from work because you were really needed at home in the past three months?
         ……………..days.
2b.   How many days have you been absent from work because you had to visit services (including courses) due to the behavior problems of your child in the past three months?
         ……………..days.

3.   Were you hindered at work by the behavior problems of your child in the past
        three months or did you have the feeling that you were functioning less optimal
        than you usually do?
O   No (continue with question 6)
O   Yes, a little
O   Yes, very much

4. Circle the number that fitted your situation best in the past three months.

I did go to work, but as a consequence of the behavior problems of my child:

	never	sometimes	often	always
a. I experienced concentration problems	1	2	3	4
b. I had to work more slowly than I usually do	1	2	3	4
c. I had to withdraw from a situation	1	2	3	4
d. I experienced problems in decision making	1	2	3	4
e. I had to postpone work	1	2	3	4
f. I had other taking over my work	1	2	3	4
g. I experienced other problems, such as ………………………………………………………………	1	2	3	4

5.   If you had to complete the tasks that you had to postpone at work in the past
        three months, how many hours would it take to do this?
        …………..hours.

6.   What are your wages (after taxes) from your job? Note: this question is about
        your wages, without the wages of your partner.
        ……………Euro's a months

The answer to this question allows us to estimate the costs of time lost more accurately. If
you object to filling out your wages, do not answer this question.

Question 7 and 8 are meant for people who do currently not hold a paid job.

7.   Which of the following situations applies to you (several answers are possible):
O   I take care of the household tasks and the children
O   I go to school/study
O   I do voluntary work; ……. hours a week
O   I am unemployed
O   I am unable to work (due to disability; I receive …..% Disability Benefits)
O   I am unable to work due to the behavior problems of my child

8.   If you have been working before, please fill out your former position:
………………………………………………………………………………………………..

Questions for everybody who has a job (paid and voluntary).

9.   If you work part-time or voluntary, to what extent is this due to the behavior problems of your child?
O   Not at all
O   Partly
O   Not applicable, I work full-time

If your child had no behavior problems at all, how many hours would you be working?
………………..hours a week.

Questions about jobs that are not paid

With respect to unpaid jobs, we differentiate between household tasks, doing groceries, carrying out chores in and around the house, voluntary work, activities with the children or going to school or studying. Please think of your situation in the past three months. First, we ask about the hours you spent on each activity; if you have not carried out an activity, please fill out '0' hour. Next, question 12 asks whether you experienced hindrance while carrying out these activities due to the behavior problems of your child.

10.   How many hours have you spent on:
        Household tasks (e.g., cooking, cleaning, laundry)
        ………….hours a week.
        Groceries (e.g., groceries for a meal at a supermarket or shopping)
        ………….hours a week.
        Chores (e.g., maintenance of the house or garden)
        ………….hours a week.
        Activities with your children (e.g., nurturing, playing, taking the kids to school)
        ………….hours a week.

11.   It could be that parents of children with behavior problems have to ask others to do tasks in and around the house (household tasks, groceries, nurturing), due to these problems. Did you have to ask others to help you out with these tasks in the past two weeks?
(several answers are possible)

O   Yes, family members (partner, children) helped me with tasks for ………hours a week
O   Yes, other people (relatives, neighbors, volunteers) helped me for ………hours a week
O   Yes, I had a family worker helping me for …………..hours a week
O   Yes, I had other paid people (e.g., a cleaning lady) helping me for ……….hours a week
O   No, I did all tasks myself

12.   We would like to know whether you carried out the following activities in the past two weeks and whether you were hindered by your child's behavior problems while doing this. Please circle only one answer.

Household tasks (e.g., cooking, cleaning, laundry)
O I **carried out** these tasks and **was not** hindered by the problems of my child
O I **carried out** these tasks and **was** hindered by the problems of my child
O I **did not carry** out these tasks and **was not** hindered by the problems of my child
O I **did not carry** out these tasks and **was** hindered by the problems of my child

Groceries (e.g., groceries for a meal at a supermarket or shopping)
O I **carried out** these tasks and **was not** hindered by the problems of my child
O I **carried out** these tasks and **was** hindered by the problems of my child
O I **did not carry** out these tasks and **was not** hindered by the problems of my child
O I **did not carry** out these tasks and **was** hindered by the problems of my child

Chores (e.g., maintenance of the house or garden)
O I **carried out** these tasks and **was not** hindered by the problems of my child
O I **carried out** these tasks and **was** hindered by the problems of my child
O I **did not carry** out these tasks and **was not** hindered by the problems of my child
O I **did not carry** out these tasks and **was** hindered by the problems of my child

Activities with your children (e.g., nurturing, playing, taking the kids to school)
O I **carried out** these tasks and **was not** hindered by the problems of my child
O I **carried out** these tasks and **was** hindered by the problems of my child
O I **did not carry** out these tasks and **was not** hindered by the problems of my child
O I **did not carry** out these tasks and **was** hindered by the problems of my child

Damage

1.   We would like to know how often your child broke or destroyed objects (e.g.,
      scratches on a table or wall paper, broken windows, damaged furniture) at your
      home or elsewhere in the past three months, for example due to a temper tan-
      trum or frustration.
      What did your child destroy, damage or break during the past three months?

      O Nothing (you do not have to fill out the next questions, thank you for complet-
      ing this questionnaire)
      O
      ....
      ....
      ....

2.   Please estimate the costs of the objects your child damaged, destroyed or broke
      during the past three months.
      ....Euro's

3.   When your child damaged, destroyed or broke something, was your child or were
      other people physically harmed or injured?
      O No
      O Yes, please describe the injury:
      ....