Executive functioning in relation to proactive and reactive aggression in childhood and adolescence

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Preface

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Abstract

This study investigated the predictive value of executive functioning for proactive and reactive aggression in a sample of 387 secondary school boys (M_{age} 14.1 years; SD = 1.2). Additionally, the effectiveness in terms of decrease in aggressive and executive functioning problems of the *'Minder Boos en Opstandig'* ('Less Anger and Rebellion') intervention was investigated in a sample of 13 children (M_{age} at pretest 9.8 years; 3 girls). Executive functioning was assessed using the Behavior Rating Inventory of Executive Function. The Reactive Proactive Questionnaire was used as a measure of reactive and proactive aggression and the Inventory of Callous and Unemotional Traits was used to assess the influence of callous and unemotional traits. Results showed higher problem scores on the indices of the BRIEF to be uniquely predictive for reactive aggression. Several predictors on subscale level were found for reactive aggression and proactive aggression. Introducing the CU traits to the models of executive functioning as predictors of aggression did not lead to substantial differences.

Treatment effects of the MBO intervention were found for both aggression and executive functioning, with significantly lower aggression scores for reactive individuals and a decrease in executive functioning problems. A focus on improving executive functioning in children and adolescents with aggression seems to be important as executive function impairments were associated with both reactive and proactive aggression. The differential influences of executive function impairments on both subtypes provide implications for treatment strategies of aggressive children and adolescents.

Key words: Reactive and proactive aggression, executive functioning, callous and unemotional traits, *Minder Boos en Opstandig* intervention, children and adolescents.

Introduction

Children with a disruptive behavior disorder (DBD), including children with oppositional defiant disorder (ODD) or a conduct disorder (CD), display disruptive behavior of a persistent character which affects several domains of their functioning (Van Goozen, et al., 2004). Although prevalence estimate rates depend on the criteria used, approximately between 5 and 10% of Western children between the age of 8 and 16 year have significant persistent oppositional, disruptive, or aggressive behavior problems (Hill, 2002). This persistence is partly caused by a lack of knowledge about the cognitive-emotional problems of these children and the neurobiological and neuropsychological factors that play a role in their problem behavior. Because of this, no appropriate interventions and treatment for these children have been developed so far (Van Goozen et al., 2004). Another issue that may play an important role in determining treatment strategies for children with aggressive behavior problems is the classification of aggression. It seems important to investigate the expression of the aggressive component in children's problem behavior because this expression has been shown to be an important predictor of behavioral outcomes in adolescents with DBD (Mathias et al., 2007). Mostly, two subtypes are identified: reactive or affective aggression, and proactive or instrumental aggression (Tharp et al., 2010).

The aim of this study is twofold. First, to obtain more insight into the neuropsychological factors underlying the subtypes of aggression, by investigating the role of executive functioning. Second, to describe an intervention that is used currently both in the Netherlands and internationally, and combine this with presenting the preliminary results of a study investigating the effectiveness of this treatment on children with proactive and reactive aggression. After discussing the theoretical background of the subject and summarizing the research that has been carried out on this topic so far, a more detailed description will be provided of the research questions, hypotheses and the research plan.

Classification of aggression; reactive and proactive aggression

In the determination of treatment strategies for children with aggressive behavior problems the classification of aggression may play an important role. Distinctions between subtypes of aggression are found in both animal and human research. The development of antisocial and aggressive behavior is thought to be heterogeneous, and caused by several different mechanisms (Marsee, & Frick, 2010; Kempes, Matthys, De Vries, & Van Engeland, 2005). One of the causes of this heterogeneity may be the presence or absence of comorbid disorders such as attention deficit hyperactivity disorder (ADHD) or mood and anxiety disorders. However, it seems that the heterogeneity of ODD and CD cannot be fully explained by this comorbidity (Kempes et al., 2005). Research findings suggest that specific subgroups can be differentiated on the basis of the types of problem behavior, the age of onset, and the development of behavior in terms of negative outcomes in later life (Marsee & Frick, 2010; Frick & Marsee, 2006; Moffit & Caspi, 2001). Individuals in different subgroups show unique cognitive and emotional correlates to their problem behavior. Examples of such cognitive and emotional correlates are: level of planning, appreciation of consequences, and affective intensity associated with the aggressive acts (Mathias et al., 2007; Marsee, & Frick, 2010; Frick, 2006).

Although multiple differences between subgroups of aggressive behaviors are described, researchers have emphasized a distinction that is primarily based on the purpose of aggression. Subtyping then leads to a distinction between impulsive, reactive, affective, or unplanned aggressive behavior on the one hand, and premeditated, proactive, instrumental, predatory, or controlled antisocial behavior on the other (e.g., Atkins & Stoff, 1993; Barratt, Stanford, Kent & Felthous, 1997; Vitaro, Brendgen, & Tremblay, 2002; Mathias et al., 2007; Tharp et al., 2010). Thus, in past decades researchers have emphasized the distinction between two types of aggression based on the underlying function or motivation, resulting in the distinction between reactive and proactive aggression (Vitaro, Brendgen & Barker, 2006). Reactive aggression can be described as a spontaneous, immediate, and impulsive aggressive reaction to a provoking event that causes frustration (Mathias et al., 2007). This type of aggression has its roots in the frustration-aggression theory (Berkowitz, 1989), which describes aggression as a hostile reaction to perceived frustration. The perceived negative effect of an event determines whether or not it is valued as aversive and triggers an aggressive response (Berkowitz, 1989). This type of aggression is often accompanied by high autonomic arousal, and the strong negative emotion that can be seen as an essential characteristic of this type of aggression has caused it to be known also as ‘hot tempered’ aggression (Vitaro & Brendgen, 2005; Scarpa, Haden & Tanaka, 2010). Proactive aggression is expressed in more planned or goal-directed forms of aggression and has its roots in the social learning model of aggression (Bandura, 1973). According to this theory aggression can be seen as an acquired type of behavior that is regulated by modeling or external reinforcement contingencies. Moreover, proactive aggression is thought to be driven by anticipated rewards that follow the aggressive acts. (Barker et al., 2010; Vitaro, et al., 2006). Proactive aggression is also called cold-tempered aggression, because of a lack of emotional arousal (Scarpa, et al., 2010).

Differences between individuals displaying proactive and reactive aggressive behavior originate from several domains. Barrat and colleagues found poorer language ability in reactive individuals than in proactive individuals (Barrat, et al., 1997). Reduced executive functioning and decreased cortical activation was also found in reactive individuals, as opposed to non-aggressive adults (Villemarette-Pittman et al., 2002; Mathias et al., 2007). From the studies carried out so far one may assume a better overall functioning of individuals expressing mostly proactive aggression as compared to those expressing mainly reactive aggression. In children and adults with reactive aggression higher levels of hostile behaviors and attribution bias were found. In this group we can expect increased levels of general impulsivity, hostility, and difficulties with cognition, socialisation, and mood (Mathias et al., 2007, Atkins and Stoff, 1993).

Although much attention is given to the distinction between proactive and reactive aggression, most studies have found that the two subtypes tend to occur together. The two subtypes are highly correlated, which has been explained in two different ways (Scarpa, et al., 2010). First, within most aggressive individuals there is often a co-occurrence of both functions underlying aggression. Second, questionnaires may confound the *form* of aggression with its *function*. Because of this questionnaires capture the different forms better than they capture the motivational distinction between the two functions of the aggressive subtypes. This second explanation, however, does not fully cover the high correlation; moreover, factor analyses have confirmed a two-factor model of proactive and reactive aggression (Raine et al., 2006). Thus, perhaps subtyping of proactive and reactive aggression had best be described as continuous dimensions, whereby there is a difference in amount of aggression that is expressed on both subtypes (Hubbard, McAuliffe, Morrow, & Romano, 2010).

Classification of aggression; Callous and unemotional traits

There is a growing interest in assessing childhood precursors that may lead to psychopathology. This is because knowledge of these precursors offers a better understanding of the developmental processes that may lead to serious forms of personality disturbance. Finding these precursors will hopefully help the development of preventive interventions (e.g., Frick & White, 2008; Lynam & Gudonis, 2005). Research has uncovered several precursors that can be associated with the development of aggressive or antisocial behavior, including child characteristics and social-environmental factors. Examples of child characteristics are: neuropsychological deficits, language problems, temperament, and autonomic irregularities. Sleep disturbances, inattention, and hyperactivity are also common in children with externalizing behavior (e.g., Sakimura, Dang, Ballard, & Hansen, 2008). In the case of more social-environmental precursors one could think of peer rejection, family mental problems, poverty, or family dysfunction.

There is increasing evidence for the idea that out of the various child characteristics, callous and unemotional (CU) traits are one component of psychopathology designating an important and particularly vulnerable subgroup of antisocial youth. This subgroup seems to run an increased risk of developing aggressive and violent behavior. There are even studies that suggest CU traits to be the most important dimension for subtyping antisocial youth (Marsee & Frick, 2010; Christian, Frick, Hill, Tyler & Frazer, 1997). CU traits seem to be associated especially with more proactive and instrumental forms of aggression (Frick, et al., 2003; Pardini, Lochman, & Frick, 2003). Muñoz et al. (2008) found a relation between reduced emotional reactivity to low levels of provocation and a high level of CU traits in proactive individuals. Social cognitive and affective differences found between reactive and proactive aggression may be due to the differences in the association with CU traits. A substantial number of studies suggest that CU traits designate an important subgroup of antisocial individuals who differ not only in the severity and stability of their behavior but also in important emotional, cognitive, and social characteristics (Frick & Viding, 2009). Research has supported the relative stability of traits from late childhood to early adolescence and from childhood into adulthood. Some of these studies also found a decrease in CU traits over time, a decrease found to be related to contextual factors (Marsee & Frick, 2010). Because contextual factors may be influenced by therapy, these results might be of interest for the development and evaluation of treatments.

For this study the question is whether and in what way CU traits influence the relation between executive functioning on the one hand, and reactive and proactive aggression on the other.

Executive functioning

Executive functioning is generally viewed as a multidimensional construct covering the higher-order cognitive processes used to regulate one's behavior and thoughts, and providing the opportunity to act in a goal-directed manner. What is more, executive functions are the self-control and self-regulation functions of the brain, including selective attention, decision making, voluntary response inhibition, task switching and working memory (Herba, Tranah, Rubia, & Yule, 2006; Blakemore & Choudhury, 2006; Vriezen & Pigott, 2002). These functions involve cognitive and emotional components as well as overt behaviors (Donders, 2002). Although there is general agreement that such higher-order executive functions play a role in cognition, there is no consensus as to what these functions are, how they are organized, or which specific test should be used in the assessment of each separate one (Packwood, Hodgetts, & Tremblay, 2011).

There are three different approaches towards defining the concept of executive functioning (Zelazo, Müller, Frye, & Marcovitch, 2003). The first theory explains executive functioning as a higher-order cognitive mechanism or ability, proposing an unitary mechanism that is responsible for all processes involving attentional control. This idea of a single executive entity has been criticized for lacking specificity (Baddeley, 1996). The second approach tries to reveal the underlying structure of executive functioning by using neuropsychological tests and factor analysis to unravel this structure. This approach does not aim at understanding underlying cognitive processes, and some researchers argue that it is questionable to try to understand and explain the structure of executive functioning without knowing more about these processes. The labels derived from factor analyses can create the impression that the cognitive processes underlying of tasks have been unravelled. However, tasks can be clustered in different ways, and characterized by different labels. The correlations between tasks and the interactions between different cognitive processes are also difficult to unravel by means of factor analyses. Without understanding the underlying processes it remains unclear what the different labels can contribute to the understanding of the structure of executive functioning (Zelazo et al., 2003). The third and last approach follows Luria (1973) by seeing executive functioning as a functional construct. In this perspective executive functioning is not explained, but there is a basis for formulating an explanation by means of hypotheses regarding the role of basal cognitive processes (such as attention, perception, memory, and action monitoring) in different aspects of executive functioning. Thus, well-defined measures of specific aspects of executive functioning are developed, and the ways in which the various aspects of executive functioning interact are clarified. Here, executive functioning is treated as a multidimensional rather than a one-dimensional construct (Riccio, Hewitt, & Blake, 2011; Zelazo et al., 2003).

Behavioral studies using various standard executive functioning tasks have also found results supporting a multifaceted model above a unitary model. The three components of executive functioning: working memory, shift and response inhibition are found to be correlated, but at the same time also clearly separable constructs. Structural equation modelling suggests that the three functions contribute differently to performance on complex executive tasks (Miyake et al., 2000). On the basis of this model, other studies were performed finding both multidimensional and simple unitary structures (e.g., Huizinga, Dolan & van der Molen, 2006; Wiebe, Espy & Charak, 2008; Wiebe et al., 2010; Letho, Juujärvi, Kooistra & Pulkkinen, 2003). Contrary to what was found by Miyake et al. (2000), only two latent variables, Working Memory and Shifting, were found by Huizinga et al. (2006), as well as three manifest Inhibition variables and one control factor (basic processing speed). They also found a continuation of the development of executive functioning into adolescence. An interesting difference in the results of the various studies is findings of more simple unitary structures for preschoolers (Hughes et al., 2010; Wiebe et al., 2008; Wiebe et al., 2010), and multidimensional structures of executive functioning in school-age children (Huizinga et al., 2006; Letho et al., 2003)

Thus, executive functioning can be seen as a multifaceted construct comprising processes that are necessary for goal-oriented, efficient, and adaptive (social) behavior. In this way these processes fulfil an essential role in everyday behavior (Huizinga & Smidts, 2011). Executive dysfunctioning consists of several quite different symptoms such as perseverations, impulsivity, lack of initiative, lack of persistence, and intruding of task-irrelevant behavior or inflexibility (Egeland & Fallmyr, 2010). Neuropsychological and neurological deficits associated with executive functions are risk factors for the development of antisocial behavior in children and adolescents (Raine, 2002a). From a neuropsychological perspective, orbitofrontal and ventromedial prefrontal dysfunction has been associated with antisocial behavior. The anterior cingulate cortex, amygdala, and interconnected regions have also shown both structural and functional abnormalities in antisocial populations (e.g., Riccio, et al., 2011; Blair et al., 2005; Raine, 2002a; Davidson, Jackson & Kalin, 2000). Research into the development of executive functioning has largely concentrated on development during preschool years. This suggests that executive functioning emerges early (around the end of infancy) and that there are important changes during these years. The development of executive functioning during school age and the transition in adolescence has also been investigated, as well as the question how changes in cognitive, emotional, and social behaviors can be related to brain development. Frontal and prefrontal regions of the brain are involved in executive functioning and this functioning influence the cognitive and social domains. More specifically, structural changes in the adolescent frontal cortex are linked to age-related improvements in inhibitory control, working memory, and decision making (Hughes, 2011). A gradual increase in executive functioning is characteristic of adolescence, when children are more and more mastering the ability to control their thoughts and actions in order to make them consistent with their internal goals. At the same time, during adolescence a greater sensitivity to risky and reckless behavior and more vulnerability to the social evaluation of others is found (Crone, 2009; Steinberg, 2005). Although the ongoing development of the frontal and prefrontal cortices is thought to be primarily responsible for the prolonged developmental course of executive functioning, with at least some finetuning and integration of components during late adolescence, changes in executive functioning occurring between early and late adolescence are also associated with the maturation of the anterior cingulated cortex (Principe, et al., 2011; Huizinga, & Smidts, 2011; Crone, 2009;Vriezen & Pigott, 2002). Studies have also found adolescence characterized by greater and more focal and increased activation in brain regions which are important for cognitive control in adults, including the parietal cortex, the lateral, and the medial prefrontal cortex (Bunge & Wright, 2007).

Executive dysfunction and aggressive behavior

Aggressive and antisocial behavior is thought to be related to deficits in executive functioning (Riccio, et al., 2011; Coolidge, DenBoer & Segal, 2004). The role of these deficits in ODD and CD, and in the co-occurrence of DBD and ADHD, has been investigated in several studies (e.g., Espy, Sheffield, Wiebe, Clark & Moehr, 2011; Riccio, et al., 2011; Van Goozen et al., 2004). Executive dysfunctions associated with antisocial behavior and aggression in children and adolescents are: impulsivity, low self-regulation, poor problem- solving skills, poor metacognition, and the inability to delay gratification (Riccio, et al., 2011; Hoaken, Shaughnessy & Pihl, 2003). Difficulties in inhibition, for instance, were found to be related to higher levels of (reactive) aggressive behaviors in adolescents (Ellis, Weiss, & Lochman, 2009). So far, studies have mostly compared children with CD and/or ODD with ADHD children, in order to investigate if the executive function deficits in children with DBD are comparable to those of children with ADHD. Inhibition problems are part of the diagnostic criteria of ODD, but the evidence for specific deficits in executive function has remained limited so far. The problems seem to be evident particularly among children with ODD and comorbid ADHD (Van Goozen et al., 2004; Hill, 2002; Miller and Cohen, 2001). Van Goozen et al. (2004) have investigated whether or not children with serious disruptive behavioral disorder show evidence of executive dysfunction. They compared children with comorbid ODD and ADHD, with ODD children. Their results did not support the idea that children with disruptive behavior (ODD) have problems in executive functioning, or more specifically in executive inhibitory control. They found an executive deficit for the ODD and comorbid ADHD group only on a set-shifting task, and concluded that children with DBD do not have a dysfunction in executive functioning, but rather suffer from a specific dysfunction in inhibition, particularly under conditions of reward. It may be the difference between 'hot' and 'cold' executive functioning that can explain these findings (Van Goozen et al., 2004). A distinction can be made between executive tasks with and without a motivational and emotional component. Tasks that involve stimuli, decisions, and outcomes that are motivationally salient for the person making them are called 'hot executive functioning tasks'. The more abstract or decontextualized tasks do not have a significant affective or motivational component and are known as 'cold executive functioning tasks' (Principe et al., 2011).

The role of the inhibitory deficit in DBD as a more 'hot' or 'cold' executive deficit may be explained by Gray's (1994) BIS/BAS theory. According to this neuropsychological theory the Behavioral Inhibition System (BIS) is regulated by the septohippocampal and prefrontal systems in the brain and inhibits behavior in response to cues of punishment or non-reward. People with an overactive BIS are inhibited and anxiety prone; those with an underactive BIS are punishment sensitive. The Behavioral Activation System (BAS), on the other hand, is mediated neurally by ascending dopaminergic fibers in the reward or appetitive systems of the brain, is activated by cues of reward or non-punishment, and therefore results in approach or active avoidant behavior. People with and overactive BAS are impulsive. A balance between BIS and BAS functioning is necessary for optimal functioning (Van Goozen et al., 2004). Differences between BIS and BAS functioning may be found between reactive and proactive aggressive individuals, because of the different functions underlying the aggressive behavior. Reactive aggression is thought to be more impulsive and may also be related to an overactive BAS, whereas proactive aggression is more planned, which may perhaps be explained by an overactive BIS.

Research investigating the differences in executive functioning between reactive and proactive aggressive individuals is scarce, and findings have been mixed. Ellis et al. (2009) found that executive functioning deficits (response inhibition and planning) were uniquely related to reactive aggression. Research suggests that reactive aggression could be uniquely related to executive functioning deficits, because the emotion-regulatory difficulties associated with this aggressive subtype can be the consequence of executive dysfunction (Ellis, et al., 2009). Neurological studies indicate that frontal lobe lesions, which as mentioned before, are linked to executive deficits, are associated only with the risk of reactive aggression, not of proactive aggression (Blaire, Peschardt, Budhani, Mitchell, & Pine, 2006). Contrary to these results, other studies show associations between deficits in executive functioning and psychopathic traits, which are more closely related to proactive aggression (e.g., Sadeh & Verona, 2008). This suggests that individuals expressing more proactive aggression might also have problems in executive functioning. More research is needed to clarify the relation between executive functioning deficits and the two subtypes of aggression.

’Minder Boos en Opstandig’ (‘Less Anger and Rebellion’)

As stated before, no interventions for children with disruptive behavior problems have yet been developed. By way of an addition to this paper the preliminary results will be presented of a project, started recently, investigating the predictors of success and failure in techniques aimed at reducing children’s disruptive behavior. The aim of this project is to define cognitive and behavioral profiles of different groups of children characterized by disruptive, aggressive or antisocial behavior in relation to the effectiveness of the ‘*Minder Boos en Opstandig’* program. This so-called MBO program is based on the Coping Power Program and is aimed at 8 to 13-year-old children with disruptive behavior disorders (DBD), and their parents. Both children and parents take part in 14 to 18 group sessions with weekly assignments. The program aims to reduce the oppositional and aggressive behavior of the child and encourage prosocial behavior by improving the parents’ parenting skills and the children’s problem-solving skills in social situations.

Van de Wiel (2002) investigated the effectiveness of treatments for children with disruptive behavior disorder by reviewing meta-analytical and other relevant studies of the treatment of school-aged DBD children. In this review two types of intervention are described as promising and having a positive affect on children with disruptive behavior problems. The first of these is Parent Management Training (PMT), which is based on a model explaining the persistence of antisocial behavior by social interactional processes between parent and child. A meta-analysis by Serketich and Dumas (1996) found an effect size of 0.86 based on 26 studies. PMT seems to be promising, although there were only few studies in which the parent training was compared with other interventions. Thus, compared to the no-treatment condition positive outcomes were found, but more research is necessary to investigate if PMT is more effective than other interventions. Parent characteristics, child characteristics, and family risk factors also appear to have a negative effect on treatment outcome (Kazdin, 1997). A second type of intervention is Cognitive Behavioral Therapy (CBT). This therapy is focused on the children and the social cognitive dysfunctions that lead to aggressive responses. The treatment provides the children with adequate problem-solving strategies and focuses on indentifying and controlling the children's negative feelings and anger (Van de Wiel, 2002). The effect of CBT in children with antisocial behavior was found to be small to moderate. A meta-analysis based on 30 studies, twelve of which also provided follow-up data, a mean effect size of 0.48 at post treatment was found, and an effect size of 0.66 at follow-up (Bennet & Gibbons, 2000). The study by Van de Wiel (2002) also reported on the effect of the Utrecht Coping Power Program (UCPP), which can be seen as a variant of the MBO intervention. Van de Wiel (2002) found effect sizes between 0.24 and 0.69 for reducing disruptive behavior, which are small to moderate. However, for the control condition (care as usual) the effect sizes were also small to moderate (0.23 to 0.54). A small difference was found between the two conditions, in favour of the UCPP-condition, on the composite between-group effect size of disruptive behavior (ES=.18). Both conditions resulted in less disruptive and more prosocial behavior, taking the child's behavior to the normal range of behavior. Within the UCPP condition some evidence was found for a mediating effect on child's behavior because of a lessened inconsistency of the mother in disciplining and improved positive involvement of the mother. Last, the UCPP intervention was found to be less expensive than care as usual. Although the findings do not suggest a greater effectivity of the UCPP compared to care as usual, the intervention seem to be a valuable addition to the existing treatments of children with DBD (van de Wiel, 2002).

In this paper the treatment effect is studied by questionnaires filled in by parents and children. Both behavioral treatment effect and possible changes in performance on executive functioning is evaluated.

Research questions and hypotheses

This study investigates if there is a difference in executive functioning between children and adolescents with proactive versus reactive aggression. Therefore, the component structure of executive function as measured by the Behavior Rating Inventory of Executive Function (BRIEF) is explored. The differences in executive functioning of aggressive individuals may help to define intervention strategies and explain the differences in effectiveness of current interventions for the subgroups.

On the basis of the literature it is hypothesized that individuals with aggressive behavior problems will display some degree of dysfunction on executive tasks, as compared to non-aggressive individuals (Espy et al., 2011; Riccio, et al., 2011; Ellis, et al., 2009; Van Goozen et al., 2004). The association of frontal and prefrontal dysfunction with antisocial behavior problems that was found in previous studies also supports the idea of executive dysfunction because of the integrity of the frontal and prefrontal regions which is necessary for appropriate executive function (Riccio, et al., 2011). This study tried to find whether reactive and proactive aggression have different executive correlates, as measured by the BRIEF.

In addition, this study investigates the influence of CU traits on the differences between reactive and proactive individuals with regarding to their executive functioning. On the basis of previous research differences may be expected. Although no consistent specific distinctive executive dysfunctions have been found for the subgroups, studies did find differences in, for example, level of planning, inhibition, and attention, to the disadvantage of reactive aggressive individuals (Mathias et al., 2007; Marsee & Frick, 2010; Ellis, et al., 2009). Because CU traits seem to be more closely correlated with proactive aggression, these traits might, in part, explain differences in executive functioning between reactive and proactive individuals (Frick et al., 2003; Pardini, et al., 2003). Specific executive deficits in proactive aggression have not been found in research so far, thus perhaps the absence of CU traits in reactive aggressive individuals may be linked to the presence of executive deficits. Therefore, executive deficits were expected to be uncorrelated to the presence of CU traits.

Finally, the effectiveness of the MBO-intervention for reactive and proactive individuals is investigated in relation to executive functioning.

Method

Participants

Two different datasets were used for this study. The first sample contained 387 boys with a mean age of 14 years and 1 month (range 12 to 17 years, *SD* = 1 year and 2 months). These participants were recruited from 11 schools of secondary education in the Netherlands. Of them, 86.7% were following some form of secondary vocational education. The other 13.3% were following other forms of secondary education like higher secondary education, pre-university education or more individual forms of secondary vocational education. Of all students 29.1% were in there first year, 27.7% in there second year, 27.2 % in there third year and the final 16% of the boys were in there fourth year of education.

Within the group of boys following secondary vocational education different learning paths are followed. The highest level, the theoretical learning path was followed by 25.5% of the boys. The mixed learning path by 8.4% and 17.6% of the boys were in the middle management oriented learning path. The basic profession oriented learning path was followed by 17.3% of the boys. The last 17.9% of the boys were in the first class of the secondary vocational education without any specific direction. Of the participants, 92.6% were of the Dutch ethnicity. The ethnicities of the other students were mainly Moroccan (1.8%), Turkish (1.8%) or Surinam (0.8%). The schools of the students were recruited randomly through the Netherlands and thereby provide a representative sample of Dutch boys in secondary vocational education.

The second sample of this study included 26 children (23 boys, 3 girls) who participated in the MBO-intervention. The children and their parents were recruited via seven centres of public health service in the Netherlands. Of the 26 children, post-test data was collected for 13 children (10 boys, 3 girls). Mean age of these children at pre-test was 9 years and 8 months (range 8.06 to 11.11 years, SD 1 years and 1 month) , at post-test 10 years and 3 months (range 8.09 to 12.05 years, SD = 1 year and 2 month).

Measurements

Proactive and reactive aggression. The Dutch version of the Reactive Proactive Questionnaire (RPQ) was completed by the children. This validated self-reported questionnaire consists of 23 items including 11 items as a measure of reactive aggression and the other 12 items as a measure of proactive aggression (Raine et al., 2006). The raw mean score of the proactive scale is significantly related to the raw mean score of the reactive scale (r = .67 in Raine et al., 2006). Confirmatory factor analysis confirmed a two-factor structure of reactive and proactive aggression within the RPQ. This finding is consistent with other studies investigating the factor structure of instruments measuring aggression (e.g. Poulin & Bouvin, 2000). Raine and colleagues (2006) found the internal reliabilities of both scales and of the total aggression scale of the RPQ were all of good values (α >.83).

Callous and Unemotional traits. Participants completed the Dutch version of the Inventory of Callous and Unemotional Traits (ICU), a validated 24-item self-reported questionnaire. Responses were given on each item on a 4-point Likert scale ranging from 0 (Not at all true) to 3 (Definitely true). A three-factor bifactor model structure with a general ‘callous-unemotional’ factor that underlies each of the items and with the three independent subfactors ‘Callousness’ (lack of empathy, guilt and remorse for misdeeds), ‘Uncaring’ (poor concern to performance on tasks or feelings of others), and ‘Unemotional’ (lack of emotional expressions) fitted the questionnaire. The three subfactors all loaded on a fourth general ‘callous-unemotional’ factor (Kimonis, Frick Skeem et al., 2008). Internal consistency of the total ICU score (α = .77 - 85) was found to be satisfactory in multiple studies (Essau et al., 2006; Kimonis, Frick, Skeem et al., 2008; Roose et al., 2010). For the subscales internal consistencies were acceptable or good with alpha coefficients ranging from .70 -.88 for the Callousness subscale, .73-.84 for the Uncaring subscale and .45-.73 for the Unemotional factor.

Executive Function: The Dutch version of the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) was completed by one of the primary caretakers of the participants. This questionnaire is developed to report children’s everyday executive skills in natural settings by means of a rating scale filled in by parents or teachers (Donders, 2002). The Parent Form of the BRIEF, used in this study, consisted of 75 questions with a three-point-scale (Never, Sometimes, Often) for answering these questions. Eight subdomains of the executive function were initially identified by principal component analysis (Gioia, Isquith, Guy, & Kenworthy, 2000). The scores on the subdomains can be summarized in two composited scores; the Behavioral Regulation Index (BRI) built up by the subdomains Inhibit, Shift, and Emotional Control, and a second composite index, the Metacognition Index (MCI) which is formed by the subdomains Initiate, Working Memory, Plan/organize, Organization of Materials, and Monitor. The two indices together can be combined to form an overall Global Executive Composite (GEC). This configuration of scale and index scores is based on the theoretical assumption that to some extent the regulatory functions measured by the BRIEF are seperatable in a clinical meaningful manner, but still related to each other in an overarching executive system (Gioia, Isquith, Retzlaff & Espy, 2002). The item content of the Monitor Scale was re-examined and hypothesized to reflect two distinct dimensions (monitoring of task related activities and monitoring of personal behavioral activities). The two subcomponents associated differently to the BRI and MCI in exploratory factor analysis with task monitoring more related to the Metacognition scales and self monitoring loaded higher on the Behavioral Regulation scales (Gioia, Isquith, Retzlaff & Espy, 2002). With the two separate dimensions of the Monitor Scale the BRIEF consisted of nine subdomains instead of the previous thought 8 domains. As a result, later research on the factor structure of the BRIEF has supported a 3 factor structure instead of the described two factor structure. After dividing the questions of the parent form in nine instead of eight subdomains, a 3-factor model of executive function with the factors Behavioral Regulation, Emotional Regulation and Metacognition. The factor Behavioral Regulation consisted of the Inhibit and Self-monitor scales, Emotional Regulation was defined by the scales Emotional Control and Shift, the Metacognition factor was build of by the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Task-Monitor scales (Gioia, Isquith, Retzlaff & Espy, 2002). Egeland & Fallmyr (2010) compared both eight and nine-scale divisions and thereby found the first empirical evidence for the superiority of a 3-factor model based on nine subdomains compared to the 2-factor model based on eight subdomains. Two validity scales of the BRIEF make it possible to detect inconsistent or primary negative response styles (Donders, 2002).

Gioia and colleagues (2000) report internal consistencies for Parent and Teacher Forms of the BRIEF as satisfactory (α = .80-.98). Huizinga and Smidts (2011) investigated the reliability and factor structure of the Dutch version of the BRIEF that was applied to a normative sample. Although the 3-factor structure was found in several studies into the parent and teacher versions applicable for children between 5 and 18 years of age, the Dutch study still applied the original eight-scale division. Cronbach's alpha for the eight clinical scales ranged from .78 to .90. For the BRI, MCI and GEC alpha coefficients were found from .93 to .96. Thereby the internal consistency of the Dutch version of the BRIEF could be considered as satisfactory (Huizinga & Smidts, 2011). Confirmatory factor analyses showed that the expected eight-factor structure fit the data reasonably and based on these eight factors or subdomains, a two-factor model fitted the data of the normative sample they used. Thus, BRI and MCI seem to be two separate factors within executive function (Huizinga & Smidts, 2011).

Statistical Analyses

All analyses were conducted using Predictive Analytic Software (PASW, version 19) The (latent) factor structure of the BRIEF was examined via maximum likelihood confirmatory factor analysis using the EQS program (EQS 6.1 for windows). The two samples required different types of analyses; therefore both procedures are described separately, starting with the procedure for the large sample.

Data of the three questionnaires measuring executive functioning, reactive and proactive aggression, and CU traits were analyzed. Reliability was estimated by determining internal consistency for the three questionnaires separately. Cronbach's alpha (α) was calculated for the subscales and indices of the questionnaires. Additionally, the item-total correlation of each item with the total score of the questionnaire was calculated. Pearson correlations were calculated in order to assess multicollinearity among predictor variables, and to assess the relation between the predictors and outcome variables.

To investigate the factor structure of the BRIEF, Principal Component Analyses (PCA) were performed, in order to discover principal components within the BRIEF without an a priori theory. With PCA first the amount of subscales within the parental ratings on the 72 items[1] of the BRIEF were investigated. The components derived from the PCA were used to investigate several factor models, using maximum likelihood confirmatory factor analysis as implemented in EQS 6.1 for Windows (Bentler, 1995). Models fit were provided by the most important fit indices: chi-square with degrees of freedom, comparative fit index (CFI), root mean square of approximation (RMSEA), and the standardized root mean-square residual (SRMR). There is an acceptable fit when: chi-square is non-significant ($p > .05$), CFI is above .90, SRMR is below .08, and RMSEA below .06.

After the determination of the amount of subdomains, these subdomains were entered in a second principal component analysis. With the outcome of this PCA, confirmatory factor analysis was conducted to investigate whether a two-factor model (Gioia, Isquith, Guy, & Kenworthy, 2000; Huizinga & Smidts, 2011) or a three-factor model would provide a reasonable fit to the current data.

[1] The Dutch BRIEF consists of 75 items, of which 72 comprise the eight clinical scales. The remaining items comprise (among) others) two validity scales 'Negativity' (extent to which the respondent answers selected BRIEF items in an unusually negative manner relative to the clinical samples) and 'Inconsistency' (extent to which respondent answers similar BRIEF items in an inconsistent manner relative to the clinical samples). Since the current study involves a normative sample, these scales were not analyzed here.

In order to assess the separate influence of each of the predictors (i.e., EF-domains from the BRIEF) on the dependent variables (reactive and proactive aggression) series of simple linear and multiple regression analyses were performed. Only cases with valid data on all variables included in the analysis were entered. Before performing the regression analyses, outliers larger then 2 standard deviations from the mean were excluded before each analysis.

Hierarchical multiple regression analyses were conducted to assess the combined contribution of the predictors to the outcome variables (reactive and proactive aggression). To assess the unique contribution of the predictors (separate subdomains of the BRIEF) to reactive aggression, proactive aggression was forced in the first block of the hierarchical regression analysis, after which the other predictors were entered. To assess the unique contribution of the predictors to proactive aggression, reactive aggression was forced in the first block of the hierarchical regression analysis, after which the other predictors were entered. Additionally, the influence of CU traits on the relation between the predictors and reactive and proactive aggression was investigated with (hierarchical) multiple regression analyses.

The second dataset was used to assess if a significant treatment effect could be found for both executive functioning and aggression. The correlations between the mean scores of the significant treatment effects for executive functioning were analyzed against the significant decrease in aggressive problems reported in order to investigate the possible relation between these effects. Because of partly non-normally distributed data Spearman's correlation's were calculated to asses multicollinearity among predictor variables and to assess the relation between the predictors and outcome variables. Normality of distribution was tested by inspecting the outcomes of the Kolmogorov-Smirnov test and the Shapiro-Wilk test. Paired-Samples T Tests and Wilcoxon signed-rank Tests were used to asses the treatment effect on both subtypes of aggression and executive functioning as measured by the BRIEF. Effect sizes were calculated with the following equation:

$$r = \sqrt{\frac{t^2}{t^2 + df}}$$

For the non-parametric test effect sizes were calculated using the following equation:

$$r = \frac{Z}{\sqrt{N}}$$

Missing Data

The data of 20 participants of the large dataset were completely missing. These cases were removed before analyses. For all analyses children with remaining missing data or a significant outlying score on predictor variables and dependent variables were excluded per analysis. This resulted in samples for analyses ranging from 248 to 378 participants. Children with missing data within the small sample, or a significant outlying score on variables were excluded analysis by analysis.

Results

Descriptives

Table 1 shows the means, standard deviations and range of the independent and dependent variables, as well as correlations between these variables. No multicollinearity was found for the independent variables, although significant correlations for all of the subscales of the BRIEF were found at the 0.01 level. Two substantial correlations (r >.9) were found. Because these are correlations between subscale and indexscore, and between indexscore and totalscore these values were of no relevance for interpretation of the regression analyses. Only one of the correlations between the subscales exceeded the .8 level and all others were below .75 indicating no multicollinearity.

Proactive and reactive aggression were found to be significantly correlated r = .58 (p < .01). All of the CU traits were significantly correlated. Significant correlations were found between both subtypes of aggression and the CU traits. However, proactive aggression was not significantly to the 'Unemotional'-dimension of the CU traits (r = .042, p >.05).

Factor Analyses BRIEF

Before performing any further analyses the factor structure of the BRIEF was investigated. A Principal Component Analysis (PCA) was conducted on the 72 items with an oblique rotation (promax). The sample size was adequate for factor analysis regarding to the Kaiser-Meyer-Olkin criterion (KMO = .93). Bartlett's test of sphericity indicates that correlations between items were sufficiently large for PCA (χ^2 =14827.26(2556), p <.001). A parallel analysis was performed to compare the variances of the components as received with the initial PCA to eigenvalues obtained by performing PCAs on random data. Based on the plot received with this analysis (Figure 1), 6 components were retained in the final analysis. Table 22 provides the factor loadings after rotation. The rotated PCA results suggested a six-factor solution. These factors together accounted for 49.7% of the total variance, which is acceptable, indicating that almost half of the variance in the data is accounted for by the first six components. The first component account for 28.5% of the variance and is build up by 21 questions regarding inhibition and emotion regulation (named 'Inhibition'). The second component explains 8.3% of the variance and consisted of 24 questions regarding working memory and planning/organization (summed as 'Working Memory'). The third component accounted for 4.5% of the variance and includes eight questions about cognitive flexibility (‘Shift’). The fourth component accounted for 3.1% of the variance and is built up by seven questions about organization of materials (‘Organization of Materials’). The fifth component accounted for 2.8% of the variance and consisted of nine questions mostly about initiating (‘Initiate’). Lastly, the sixth component accounted for 2.5% of the variance and is build up by 4 questions regarding monitor of behavior (‘Monitor’). All new factors had high reliabilities (α ≥.80).

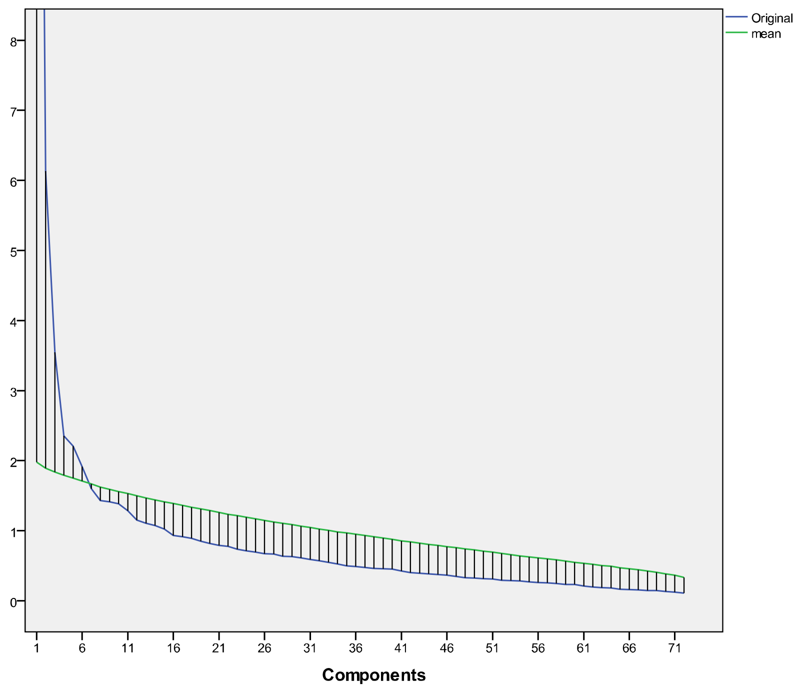

Figure 1 Results of the parallel analysis. Green line represents the mean of the random data, while the Blue line represents the plot of the eigenvalues of the original data.

After establishing the number of components, a confirmatory factor analysis (CFA) was performed to confirm or reject the component structure that was found with PCA. The decrease in Eigenvalues as expressed in the parallel analysis and visualized in Figure 1 suggested a six-factor structure. Because based on this analysis, one may conclude that the first three components explain most of the variances; also a 3 factor model was investigated with CFA. Within this analysis the three-factor model appeared to be significantly different from the observed data (χ^2 = 5711.88, *df* = 2481, *p* <. 01). Also the fit indices are indicators of an unsatisfactory fit between the model and the observed data (Table 2).

Table 1. *Correlations among dependent and independent variables with BRIEF 8 subscale-division.*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13	14.	15.	16.	17.	Mean	SD	Min	Max
1. Reactive aggression	-																	8.55	4.00	0	20
2. Proactive aggression	.576**	-																2.99	2.80	0	17
3. Callousness (CU-trait)	.296**	.375**	-															9.25	3.67	1	28
4. Uncaring (CU-trait)	.289**	.333**	.306*	-														8.91	3.31	0	22
5. Unemotional (CU-trait)	.129*	.042	.189*	.139*	-													7.15	2.31	1	14
6. Callous unemotional traits (CU-total)	.334*	.386**	.782**	.731**	.537**	-												25.24	6.49	7	45
7. Initiate	.203**	.120*	.136*	.148**	.086	.164**	-											1.79	.39	1	3
8. Working Memory	.246**	.189**	.171**	.132*	.046	.152**	.663**	-										1.73	.46	1	3
9. Plan/Organize	.228**	.211**	.252**	.205**	.082	.261**	.665**	.802**	-									1.75	.39	1	3
10. Organization of materials	.222**	.071	.154**	.152**	.009	.149**	.428**	.557**	.530**	-								1.82	.54	1	3
11. Inhibit	.372**	.329**	.142**	.249**	.018	.202**	.461**	.532**	.511**	.393**	-							1.48	.41	1	3
12. Monitoring	.223**	.155**	.154**	.188**	.057	.186**	.593**	.670**	.736**	.533**	.670**	-						1.44	.38	1	3
13. Shift	.153**	.092	.077	.056	.162**	.110*	.531**	.462**	.482**	.236**	.507**	.491**	-					1.87	.42	1	3
14. Emotional Control	.351**	.214**	.098	.196**	.098	.177**	.470**	.411**	.415**	.261**	.714**	.511**	.650**	-				1.45	.40	1	3
15. BRI	.360**	.268**	.112*	.205**	.112*	.194**	.566**	.552**	.548**	.342**	.861**	.821**	.655**	.463**	-			1.46	.35	1	3
16. MCI	.279**	.172**	.197**	.216**	.058	.214**	.785**	.882**	.885**	.761**	.604**	.510**	.833**	.913**	.614**	-		1.79	.36	1	3
17. Total	.366**	.252**	.161**	.283**	.082	.239**	.760**	.833**	.829**	.663**	.771**	.672**	.845**	.689**	.830**	.950**	-	1.66	.32	1	3

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 2: *Fit indices of the different factor solutions as provided by the CFA.*

Model	χ^2	*df*	χ^2/df	CFI	SRMR	RMSEA
3- factor- original	5711.88	2481	2.30	.693	.084	.068
6- factor-original	4859.18	2469	1.97	.773	.079	.058
8-factor-original	4463.86	2455	1.82	.809	.071	.054
Second level model	4865.88	2477	1.96	.773	.079	.058

The results of the 6-factor model suggested a better fitting model. The model still differed significantly from the observed data (χ^2 = 4859.12, *df* = 2469, p <.01) and the comparative fit index (CFI) is still below the required value of .90, but the standardized root mean-square residual (SRMR) and the root mean squared error of approximation (RMSEA) are both indicating a reasonable fit between the model and the observed data. Lastly, also an eight factor model was investigated, because literature and the manual of the BRIEF suggested that the questions the BRIEF could be divided in eight subscales. This 8-factor model also differed significantly from the observed data (χ^2 = 4463.86, *df* = 2455, p <.01) with the other fit indices indicating a approximately similar good fit of the 6-factor model. Given the lack of differences in incremental fit and comparable fit indices, the 6-factor model was preferred as it offers a simpler, more parsimonious model of the observed data.

Based on the results from both the PCA and the CFA, the 6-factor model was used to investigate the latent factor structure of the subscales of the BRIEF. Table 5 presents the means, standard deviations and correlations for these new subscales. Correlations are ranging between .21 and .70 suggesting no multicollinearity between the subscales. Principal components analyses with the 6 subscales indicate a 2 component structure with an explained variance of 72.2% accounted for by these 2 components (Table 3). The first component accounted for 54.1% of the variances and consisted of the subscales; ‘Inhibition’, ‘Shift’, and ‘Initiate’. The second component accounted for another 18.1% of the variances and is built up by the subscales; ‘Monitor’, ‘Working Memory’, and ‘Organization of Materials’. Mean raw score ratings for each of the six new BRIEF scales were entered in CFA as measured variables in a priori models with respectively 1, 2 and 3 components. The three models were compared for their adequacy of fit. Table 3 provides a summary of the fit indices. The baseline, single factor model fits the data poorly based on all fit criteria, confirming the existing of indices within the subscales. The incremental fit of the 2-factor model differed from the baseline and provides a model that fit the observed data (χ^2 *(8)* = 11.39, p = .180). Also the other fit criteria suggest this model does not significantly differ from the observed data, with a CFI exceeding the .95 criterion, a SRMR of .03 and a RMSEA of .03. Because previous research has suggested a 3-factor structure and the structure of eigenvalues as shown by the PCA also suggested a possible 3-factor solution, this model was tested with CFA. This 3-factor solution also fitted the observed data with fit-indices indicating a reasonable fit (Table 4). Because the 2-factor solution offered the best fit-indices with a more parsimonious model, this model was chosen to be the best model. Figure 2 presents the parameter estimates of this final model. With the knowledge of both analyses also a second level model was performed investigating both the latent factor structure of the 72 questions and the latent factor structure of the subscales. The incremental fit indices of this overall model are added to Table 3. The almost identical model fit to the 6-factor model indicates a high amount of variance explained by the six factors. Based on the PCA and CFA still an underlying two factor structure of the six subscales is argued.

Table 3. *Summary rotated factor solution for the BRIEF-subscales* (*N =378)*

	Rotated Factor Loadings	
Subscale	BRI	MCI
Inhibition	**.846**	.481
Shift	**.839**	.289
Initiate	**.829**	.449
Monitor	.299	**.903**
OrganizationOfMaterials	.446	**.778**
Working Memory	.664	**.759**
Eigenvalues	2.613	2.613
% of variance	54.12	18.07
α	.81	.75

Table 4. *Summary of Fit Indices for the BRIEF models based on the 6 subscales.*

Model	χ^2	*df*	*p*	χ^2/df	CFI	SRMR	RMSEA
1-factor	37.68	9	<.001	4.18	.933	.048	.091
2-factor	11.39	8	.180	1.43	.992	.026	.033
3-factor	7.83	4	.098	1.96	.989	.025	.050

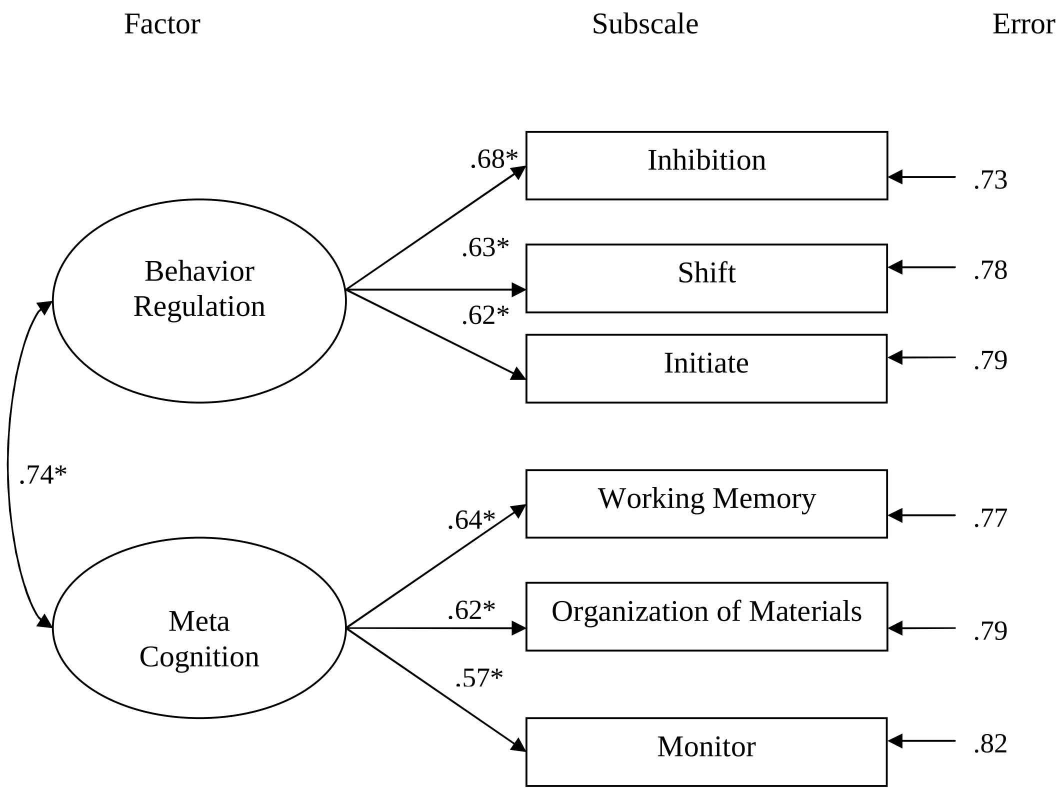

Figure 2. Parameter estimates of the standardized solution for the two-factor model based on six subscales. Confirmatory factoranalysis model, standardized maximum likelihood parameter estimates * p<.05.

Table 5. *Correlations among all dependent and independent variables with BRIEF 6 subscale-divisions.*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13	14.	15.	Mean	SD	Min	Max
1. Reactive aggression	-															8.55	4.00	0	20
2. Proactive aggression	.576**	-														2.99	2.80	0	17
3. Callousness (CU-trait)	.296**	.375**	-													9.25	3.67	1	28
4. Uncaring (CU-trait)	.289**	.333**	.306*	-												8.91	3.31	0	22
5. Unemotional (CU-trait)	.129*	.042	.189*	.139*	-											7.15	2.31	1	14
6. Callous unemotional traits (CU-total)	.334*	.386**	.782**	.731**	.537**	-										25.24	6.49	7	45
7. Working Memory	.250**	.209**	.212**	.184**	.043	.204**	-									1.79	.40	1	3
8. Inhibition	.390**	.206**	.132*	.251**	.077	.221**	.539**	-								1.53	.39	1	3
9. Shift	.173**	.112*	.060	.034	.159**	.087	.428**	.574**	-							1.39	.39	1	3
10. Organization of Materials	.222**	.071	.154**	.152**	.009	.149**	.572**	.376**	.215**	-						1.82	.54	1	3
11. Initiate	.201**	.089	.125*	.133*	.152**	.175**	.520**	.596**	.592**	.338**	-					1.63	.37	1	3
12. Monitor	.143**	.131*	.143**	.143**	.058	.154**	.574**	.342**	.206**	.462**	.328**	-				2.01	.59	1	3
13. BRI	.324**	.208**	.091	.169**	.161**	.179**	.578**	.855**	.846**	.361**	.847**	.356**	-			1.51	.33	1	3
14. MCI	.236**	.154**	.198**	.210**	.043	.208**	.824**	.479**	.333**	.816**	.467**	.845**	.496**	-		1.87	.43	1	3
15. Total	.346**	.237**	.150*	.277**	.086	.230**	.822**	.733**	.620**	.699**	.722**	.721**	.825**	.900**	-	1.68	.32	1	3

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Descriptives of the new subscale division of the BRIEF

Table 5 provides means, standard deviations and range of the independent and dependent variables, as well as correlations between variables. No multicollinearity was found for the independent variables, although significant correlations for all of the subscales of the BRIEF were found at the 0.01 level. With the new scales only one substantial correlation (r >.9) was found, namely between the Metacognition Index and the Total Score. None of the correlations between the subscales exceeded the .8 level indicating no multicollinearity.

Preliminary analyses

First, as shown in Table 6, proactive aggression was found a significant predictor of reactive aggression (β = .613, p <.001) and reactive aggression a significant predictor of proactive aggression (β = .596, p <.001). Proactive aggression accounts for 37.6% of the variances in reactive aggression, while reactive aggression accounts for 35.5% of the variance in proactive aggression.

Table 6. *Single linear regression reactive and proactive aggression.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	p	F	R^2	β	p
(Constant)	211.81 (1,251)**	.376		.000	188.3 (1,342)**	.355		.815
Proactive/Reactive aggression			.613	.000			.596	.000

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 7a presents a single linear regression of the Totalscore of the original BRIEF upon the dependent variables proactive and reactive aggression and the multiple regressions with the two index scores. Table 8a presents the multiple regressions with the original eight Subscales. As shown, the Total score of the BRIEF was found to be a significant predictor for both reactive (β = .415, p <.001) and proactive aggression (β = .251, p <.001). The Totalscore accounted for 17.2% of the explained variance in reactive aggression and for 6.3% of the explained variance in proactive aggression. The Metacognition Index was found a significant predictor only for reactive aggression (β = .160, p = .022). The Behavioral Regulation Index was found to be a significant predictor for both reactive (β = .315, p <.001) and proactive aggression (β = .181, p = .016). The indices accounted for 18.7% of the variance in reactive aggression and 7.1% of the variance in proactive aggression. When investigating both indices by looking at the subscales scores beginning with the Behavioral Regulation Index; Inhibition was found a significant predictor of both reactive (β = .181, p =.046) and proactive aggression (β = .410, p <.001). Emotional control was found to be a significant predictor of reactive aggression (β = .310, p <.001). In addition, Shift was found to be a significant predictor of proactive aggression (β = -.192, p = .011). The Beta-sign is negative, indicating the higher values for problems reported on Shift, the lower the score for proactive aggression. This seems remarkable given the positive correlation that was found in the preliminary analysis (Table 1). This can be explained by the influence of the other predictor variables on this predictor variable. Including for example Emotional Control in a model with Shift turns the positive Beta-sign into a negative Beta-sign. So, with multiple predictor variables relations between single predictor and dependent variables can not be interpreted separately. With regards to the subscales of the Metacognition Index; Plan/Organize was found to be a significant predictor of reactive aggression (β = .237, p =.023) and proactive aggression (β = .376, p <.001). The subscales accounted for 25.7% of the variance in reactive aggression, and 14.8% of the variance in proactive aggression.

Table 7a. *Multiple regressions with BRIEF original Total and Index scores.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	*p*	*F*	R^2	β	*p*
(Constant)	56.437(1,271)**	.172		.828	17.925(1,267)**	.063		.728
BRIEF Total			.415	.000			.251	.000
(Constant)	31.007(2,270)**	.187		.791	10.092(2,265)**	.071		.654
BRIEF BRI			.315	.000			.181	.016
BRIEF MCI			.160	.022			.114	.127

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 7b. *Multiple regressions with BRIEF new Total and Index scores.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	*p*	*F*	R^2	β	*p*
(Constant)	69.851(1,260)	.212		.807	14.880(1,261)	.054		.920
BRIEF Total			.460	.000			.232	.000
(Constant)	31.934(2,261)**	.197		.948	8.477(2,256)	.062		.974
BRIEF BRI			.283	.000			.089	.200
BRIEF MCI			.230	.000			.193	.006

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 7b presents the regressions of the Totalscore and indexscores based on the six new subscales of the BRIEF. Table 8b presents the multiple regressions with these new subscales. As shown, the Totalscore is a significant predictor of both reactive and proactive aggression (reactive: β = .460, p <.001; proactive: β = .232, p <.001). The Totalscore accounted for 21.2% of the explained variance in reactive aggression and for 5.4% of the explained variance in proactive aggression Regarding the indices, different results were found as compared to the original BRIEF. The Behavioral Regulation Index is still a significant predictor of reactive aggression (β = .283, p <.001), but no longer of proactive aggression (β = .089, p = .200). At the same time, the Metacognition Index was found to be a significant predictor of proactive aggression (β = .193, p =.006) as well as a predictor of reactive aggression (β = .230, p <.001). The indices accounted for 19.7% of the variance in reactive aggression and 6.2% of the variance in proactive aggression. With the six new subscales, Organization of Materials was found to be significant predictor of reactive aggression (β = .166, p =.013). Inhibition was found a significant predictor of both reactive (β = .341, p <.001) and proactive aggression (β = .373, p <.001). The subscale Shift is a significant predictor of proactive aggression (β = -.147, p =.045). The original subscale Plan/Organize no longer exists within the six subscale-division. The new subscales accounted for 22.6% of the variance in reactive aggression and 19.1% of the variance in proactive aggression.

Table 8a. *Multiple regressions with BRIEF original subscales.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	p	F	R^2	β	p
(Constant)	9.628(8,264)**	.226		.490	7.625(8,259)**	.191		.791
Inhibition			.181	.046			.410	.000
Shift			-.142	.057			-.192	.011
Emotional Control			.310	.000			.061	.487
Initiate			-.011	.884			-.102	.197
Working Memory			-.037	.707			-.077	.444
Plan/Organize			.237	.023			.376	.000
Orga.of Materials			.114	.093			-.016	.814
Monitor			-.114	.229			-.165	.087

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 8b. *Multiple regressions with BRIEF new subscales.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	p	F	R^2	β	p
(Constant)	14.749(6,256)**	.257		.825	7.352(6,253)**	.148		.790
Working Memory			.089	.263			.147	.083
Inhibition			.341	.000			.373	.000
Shift			.011	.873			-.147	.045
Orga. of Materials			.166	.013			-.054	.449
Initiate			-.011	.881			-.126	.104
Monitor			.032	.628			.098	.174

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Callous-Unemotional Traits.

Table 9 presents single linear regressions of the total index for CU traits and the multiple linear regressions of the three subscales of CU traits upon the dependent variables proactive and reactive aggression. The total score of the CU traits was found to be a significant predictor for both reactive (β = .369, p <.001) and proactive aggression (β = .378, p <.001), accounting for 13.6% of the variance in reactive aggression and 14.3% in proactive aggression. When investigating the subscales of the CU traits, Callousness was found to be a significant predictor of reactive (β = .219, p <.001) and proactive aggression (β = .292, p <.001). In addition, Uncaring was found a significant predictor of both reactive (β = .234, p <.001) and proactive aggression (β = .262, p <.001). The subscales of the CU traits accounted for 14.3% of the variance in reactive aggression and 19% in proactive aggression.

When controlling for proactive aggression (Table 10), Callousness is no longer a significant predictor of reactive aggression (β =.091, p = .067). Uncaring remains a significant predictor of reactive aggression, above and beyond the effect of proactive aggression (β =.121, p = .015). The introduction of Callousness and Uncaring to the model significantly increases the explained variance (R^2 -change = .026, F(2,322) = 6.541, p = .002). Introducing reactive aggression in the first step (Table 11), both Callousness and Uncaring remained significant predictors of proactive aggression, above and beyond the effect of reactive aggression (Callousness:. β =.189, p <.001; Uncaring: β =.189, p = .026). The introduction of Callousness and Uncaring to the model leads to an significant increase in explained variance (R^2 -change = .055, F(2,312) = 13.744, p <.001).

Table 9. *Single and Multiple linear regressions of CU traits and proactive vs. reactive aggression.*

	Reactive Aggression				Proactive Aggression			
	F	R^2	β	p	F	R^2	β	p
(Constant)	52.242(1,332)**	.136		.000	54.332(1,326)	.143		.210
ICU Total			.369	.000			.378	.000
(Constant)	18.520(3,332)**	.143		.000	25.466(3,325)**	.190		.826
Callousness			.219	.000			.292	.000
Uncaring			.234	.000			.262	.000
Unemotional			.019	.721			-.061	.236

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 10. *Hierarchical regression analyses; ICU subscales predicting reactive aggression.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	*β*	*p*
Reactive aggression	Model 1	(Constant)	167.834(1,324)**	.338	6.278	.245		.000
		Proactive Aggression			.782	.061	.582	.000
	Model 2	(Constant)	61.458 (3,322)**	.364	4.476	.554		.000
		Proactive aggression			.681	.066	.507	.000
		Callousness			.095	.052	.091	.067
		Uncaring			.138	.056	.121	.015

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 11. *Hierarchical regression analyses; ICU subscales predicting proactive aggression.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	147.510 (1,314)**	.320	.073	.219		.738
		Reactive aggression			.289	.024	.565	.000
	Model 2	(Constant)	62.324 (3,312)**	.369	-1.126	.316		.000
		Reactive aggression			.249	.024	.487	.000
		ICU Callousness			.105	.027	.189	.000
		ICU Uncaring			.066	.030	.108	.026

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Executive functioning

Analysis were performed for both the original and the new factor structures. For the original division, the Metacognition index is built up by the subscales: Initiate, Working Memory, Plan/organize, Organization of Materials, and Monitor. The Behavioral Regulation Index is built up by the subscales: Inhibit, Shift, and Emotional Control. For the new factor structure, the Metacognition Index is formed by the subscales: Working Memory, Organization of Materials, and Monitor, while the Behavior Regulation Index is built up by the subscales: Inhibition, Shift, and Initiate.

Multiple hierarchical regressions on reactive aggression (Table 12a) show that with the introduction of proactive in the fist step both indices are still significant predictors of reactive aggression above and beyond proactive aggression. With the introduction of both indices to the model, the explained variance significantly increased (R^2 -change = .065, $F(2,257) = 15.002$, $p < .001$). When introducing reactive aggression (Table 13a), the predictive value of the original Behavioral Regulation Index on proactive aggression as found in the multiple regression ($\beta = .181$, $p = .016$) disappears. For the new indices, introducing proactive in the first step also does not change the predictive value of both indices on reactive aggression (Table 12b). The new indices thereby account for 7.5% of the explained variance in reactive aggression above and beyond proactive aggression. The introduction of reactive (Table 13b), makes that the Metacognition Index no longer can be seen as a significant predictor of proactive aggression (β = .059, p = .236).

Table 12a. *Hierarchical regression analyses; original indexscores predicting reactive aggression.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	β	*p*
Reactive aggression	Model 1	(Constant)	157.09(1,259)**	.378	5.901	.278		.000
		Proactive aggression			.932	.074	.614	.000
	Model 2	(Constant)	68.027(3,257)**	.443	1.112	.927		.232
		Proactive aggression			.817	.074	.539	.000
		BRIEF BRI			.065	.024	.161	.008
		BRIEF MCI			.032	.014	.134	.025

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 12b. *Hierarchical regression analyses; new indexscores predicting reactive aggression.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	β	*p*
Reactive aggression	Model 1	(Constant)	156.53(1,256)**	.379	5.940	.278		.000
		Proactive Aggression			.925	.074	.616	.000
	Model 2	(Constant)	70.425(3,254)**	.454	.653	.935		.486
		Proactive aggression			.814	.072	.542	.000
		BRIEF BRI			2.199	.634	.187	.001
		BRIEF MCI			1.229	.478	.139	.011

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 13a. *Hierarchical regression analyses; original indexscores predicting proactive aggression.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	β	*p*
Proactive Aggression	Model 1	(Constant)	155.27(1,298)**	.343	.040	.213		.850
		Reactive aggression			.288	.023	.585	.000
	Model 2	(Constant)	77.378(2,297)**	.343	.013	.401		.974
		Reactive aggression			.288	.025	.584	.000
		BRIEF BRI			.023	.283	.004	.936

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 13b. *Hierarchical regression analyses; new indexscores predicting proactive aggression.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	142.44(1,284)**	.332	.003	.235		.989
		Reactive aggression			.305	.026	.578	.000
	Model 2	(Constant)	72.03(2,283)**	.333	-.462	.456		.312
		Reactive aggression			.298	.026	.564	.000
		BRIEF MCI			.282	.237	.059	.236

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 14a provides a summary of the original subscales that significantly predicted reactive aggression. When controlling for proactive aggression, the subscales Emotional Control (β =.212, p = .001) is still a significant predictor of reactive aggression. Inhibition and Plan/Organize are no longer significant predictors of reactive aggression (Inhibition: β = .032, p =.644; Plan/Organize: β = .056, p =.274). By adding Emotional Control to a model with proactive aggression, the explained variance significantly increases (R^2 -change = .065, F(3,297) = 11.366, p <.001). When controlling for reactive aggression (Table 15a), Inhibition, Shift and Plan/Organize remain significant predictors of proactive aggression. Introducing the subscales leads to an increase in explained variance (R^2 -change = .048, F(2,257) = 7.372, p <.001). For the new subscales (Table 14b), all subscales that were significant remain significant predictors of reactive aggression after introducing proactive aggression in the first step. Introducing the subscales to the model increases the explained variance significantly (R^2 -change = .080, F(2,299) = 22.274, p <.001). With the introduction of reactive aggression in the first step (Table 15b), Inhibition and Shift are significantly predicting proactive aggression above and beyond reactive aggression. Adding the two subscales leads to an increase in explained variance (R^2 -change = .016, F(2,301) = 15.002, p =.027).

Table 14a. *Hierarchical regression analyses; original subscales predicting reactive aggression.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Reactive aggression	Model 1	(Constant)	177.33(1,300)**	.372	5.976	.264		.000
		Proactive Aggression			.930	.070	.610	.000
	Model 2	(Constant)	57.453(4,297)**	.436	2.006	.823		.015
		Proactive aggression			.817	.072	.536	.000
		Inhibition			.289	.625	.032	.644
		Emotional Control			1.986	.581	.212	.001
		Plan/Organize			.542	.494	.056	.274

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table14b. *Hierarchical regression analyses; new subscales predicting reactive aggression.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Reactive aggression	Model 1	(Constant)	185.12 (1,301)**	.381	6.119	.253		.000
		Proactive Aggression			.883	.065	.617	.000
	Model 2	(Constant)	85.28(3,299)**	.461	1.752	.700		.013
		Proactive aggression			.773	.064	.540	.000
		Inhibition			1.585	.444	.171	.000
		Organization of Materials			1.249	.319	.181	.000

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 15a . *Hierarchical regression analyses; original subscales predicting proactive aggression.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	137.99(1,295)**	.319	.097	.222		.663
		Reactive aggression			.284	.024	.565	.000
	Model 2	(Constant)	42.26 (4,292)**	.367	-.311	.473		.511
		Reactive aggression			.252	.025	.501	.000
		Inhibition			.853	.282	.176	.003
		Shift			-1.081	.292	-.201	.000
		Plan/Organize			.558	.280	.112	.047

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 15b . *Hierarchical regression analyses; new subscales predicting proactive aggression.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	148.989 (1,303)**	.330	.067	.219		.761
		Reactive aggression			.289	.024	.574	.000
	Model 2	(Constant)	52.977 (3,301)**	.346	.109	.401		.786
		Reactive aggression			.275	.025	.546	.000
		Inhibition			.660	.285	.136	.021
		Shift			-.668	.278	-.133	.017

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

The influence of CU traits on the predictive role of Executive Functioning.

As shown, when controlling for ICU Uncaring, both the original and new indices remain significant predictors of reactive aggression (Tables 16a, 16b). Introducing the original indices to a model with only Uncaring increases the explained variance significantly (R^2 -change = .138, $F(2,256) = 24.055$, p <.001). For the new indices the explained variance also significantly increases (R^2 -change = .146, $F(2,252)$ = 8.565, p <.001).

Table 16a. *Hierarchical regression analyses; original indices predicting reactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	*β*	*p*
Reactive Aggression	Model 1	(Constant)	38.152(1,258)**	.129	4.849	.646		.000
		ICU Uncaring			.417	.068	.359	.000
	Model 2	(Constant)	31.027(3,256)**	.267	-1.347	1.094		.219
		ICU Uncaring			.280	.065	.241	.000
		BRIEF BRI			.099	.027	.247	.000
		BRIEF MCI			.044	.016	.186	.007

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 16b. *Hierarchical regression analyses; new indices predicting reactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	*β*	*p*
Reactive Aggression	Model 1	(Constant)	41.009 (1,256)**	.138	4.739	.634		.000
		ICU Uncaring			.424	.066	.372	.000
	Model 2	(Constant)	29.194 (3,254)**	.256	-1.100	1.093		.315
		ICU Uncaring			.306	.065	.268	.000
		BRIEF BRI			2.454	.719	.216	.001
		BRIEF MCI			1.727	.561	.198	.002

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 17a presents the regression analysis investigating the influence of the CU-trait Uncaring on the original subscales predicting reactive aggression. After introducing Uncaring; Emotional Control remains to be a significant predictor of reactive aggression above and beyond Uncaring. Introducing the subscale to the model significantly increases the explained variance (R^2 -change = .116, $F(1,325) = 49.949$, p <.001)

Table 17a. *Hierarchical regression analyses; original subscales predicting reactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	*β*	*p*
Reactive Aggression	Model 1	(Constant)	46.785 (1,326)**	.126	4.770	.585		.000
		ICU Uncaring			.423	.062	.354	.000
	Model 2	(Constant)	51.880 (2,325)**	.242	.757	.788		.337
		ICU Uncaring			.348	.059	.291	.000
		Emotional Control			3.211	.454	.347	.000

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

For the new subscales, both Inhibition and Organization of Materials remain to be significant predictors of reactive aggression after introducing Uncaring (Table 17b). Adding these predictors to a model with Uncaring increases the explained variance significantly (R^2 -change = .151, $F(2,300) = 31.678$, p <.001). After introducing Uncaring in the first step (Table 18a), the original subscales remain significant predictors of proactive aggression. Adding those subscales to the model increases the explained variance significantly (R^2 -change = .109, $F(3,299) = 13.839$, p <.001). For the new subscales (Table 18b introducing Uncaring leads to a no longer significant effect for Shift as predictor of proactive aggression (β =-.075, p = .243).

Table 17b *Hierarchical regression analyses; new subscales predicting reactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	β	*p*
Reactive Aggression	Model 1	(Constant)	46.783 (1,302)**	.134	4.913	.593	4.913	.000
		ICU Uncaring			.425	.062	.425	.000
	Model 2	(Constant)	39.881 (3,300)**	.285	-.397	.861	-.397	.645
		ICU Uncaring			.296	.059	.296	.000
		Inhibition			2.699	.503	2.699	.000
		Orga.of Materials			1.303	.370	1.303	.000

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 18a. *Hierarchical regression analyses; original subscales predicting proactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	R^2	*B*	*SE*	β	*p*
Proactive Aggression	Model 1	(Constant)	36.676 (1,302)**	.108	.598	.364		.101
		ICU Uncaring			.235	.039	.329	.000
	Model 2	(Constant)	20.718 (4,299)**	.217	-1.450	.632		.022
		ICU Uncaring			.163	.038	.229	.000
		Inhibition			1.757	.352	.317	.000
		Shift			-.842	.369	-.139	.023
		Plan/Organize			.740	.364	.127	.043

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 18b. *Hierarchical regression analyses; new subscales predicting proactive aggression, controlling for ICU-Uncaring.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	41.316 (1,300)**	.121	.624	.300		.039
		ICU Uncaring			.207	.032	.348	.000
	Model 2	(Constant)	21.229 (3,298)**	.176	-.491	.476		.303
		ICU Uncaring			.168	.033	.283	.000
		Inhibition			1.286	.306	.277	.000
		Shift			-.356	.305	-.075	.243

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 19a . *Hierarchical regression analyses; original subscales predicting proactive aggression, controlling for ICU-Callousness.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	48.420 (1,289)**	.144	.649	.316		.041
		ICU Callousness			.222	.032	.379	.000
	Model 2	(Constant)	23.632 (4,286)**	.248	-.881	.582		.131
		ICU Callousness			.194	.031	.331	.000
		Inhibition			1.738	.326	.335	.000
		Shift			-1.069	.342	-.190	.002
		Plan/Organize			.430	.355	.078	.227

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 19b. *Hierarchical regression analyses; new subscales predicting proactive aggression, controlling for ICU-Callousness.*

Dependent variable		*Predictor*	F (df,df)	*R²*	*B*	*SE*	*β*	*p*
Proactive Aggression	Model 1	(Constant)	55.995 (1,288)**	.163	.521	.283		.067
		ICU Callousness			.215	.029	.403	.000
	Model 2	(Constant)	26.646 (3,286)**	.218	-.696	.471		.140
		ICU Callousness			.197	.028	.369	.000
		Inhibition			1.280	.297	.275	.000
		Shift			-.403	.302	-.084	.183

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Introducing Callousness to the original subscales (Table 19a), makes Plan/Organize no longer a significant predictor of proactive aggression, while Shift and Inhibition remain significant predictors. Introducing of these significant subscales to the model leads to an increase in explained variance (*R²* -

change =. 105, $F(3,286)$ =13.308, p <.001). For the new subscales (Table19b), Shift is no longer a significant predictor of proactive aggression after the introduction of Callousness in the first step (β =-.084, p = .183).

Treatment effects of the MBO-Intervention

Table 20 shows the means, standard deviations and range of the independent and dependent variables at pre- and posttest. At post treatment a significant smaller amount of total aggression and reactive aggression was found as well as decreases in executive functioning problems.

Pre-posttreatement comparisons are shown in Table 21. On average, the children reported significantly lower scores for total aggression after they participated in the training (M = 12.42, SE = 2.56) than they did beforehand (M = 18.92, SE = 7.92), $t(11)$ = 3.493, p <.05, r =.73. Also the scores on reactive aggression were significantly lower (M = 8.75, SE = 1.72) compared to the scores reported before participating (M = 13.42, SE = 1.30), $t(11)$ = 4.204, p <.05, r =. 79. For proactive aggression, no significant treatment effect was found. Paired-Samples T Tests and Wilcoxon signed-rank Tests were used to asses the treatment effect on both subtypes of aggression and executive functioning as measured by the BRIEF. For executive functioning as measured by the original BRIEF 8 subscale division, significant treatment effects were found for the Totalscore on executive functioning and the score on Behavioral Regulation Index. On subscale level significant treatment effects were found for Inhibition, Shift, Emotion Regulation, Working Memory and Initiate. Totalscore of problems with regarding to executive functioning was significantly lower after the intervention (z = 2.134, p <.05, r = .44). Also a significant treatment effect was found for the Behavior Regulation Index (z = 2.434, p <.05, r = .50).

Subscale treatment effects were found for Inhibition (z = 2.053, p <.05, r = .42), Shift (z = 1.975, p <.05, r = .39), and Emotional Control (M = 2.15, SE = .13), $t(12)$ = 2.432, p<.05, r =. 57). Also scores for Working Memory were significantly lower after participating in the intervention (M = 1.88, SE = .14) than they were reported on forehand (M = 2.10, SE = .14), $t(12)$ = 2.642, p<.05, r =.61. Lastly, parents reported significantly lower scores on problems with regarding to Initiate (M = 1.79, SE = .15) than they did before the intervention (M = 2.00, SE = .16), $t(12)$ = 2.513, p<.05, r =.59.

For the six subscale division of the BRIEF, a significant treatment effect was found for Behavioral Regulation on the index level (z = 2.353, p <.05, r = .048). Also a significant treatment effect was found for Inhibition(z = 2.606, p <.05, r = .53). Problems reported regarding Working Memory were lower after the intervention (M = 1.82, SE = .13) than they were before (M = 1.99, SE = .12), $t(11)$ = 2.288, p<.05, r =.57. Lastly lower scores on Initiate were reported (M = 1.79, SE = .15) than they were reported on forehand (M = 2.03, SE = .15), $t(12)$ = 2.214, p<.05, r =.54.

Lastly, the correlations between the decreases in aggressive behavior and the decreases in executive functioning problems were investigated. No significant correlations were found between the decrease in total and reactive aggression with either one of the executive function measures.

Table 20a *Descriptives pretest*

	N	*M*	*SD*	Min	Max
Total aggression	13	18.23	7.40	5	29
Reactive aggression	13	13.04	4.48	4	20
Proactive aggression	13	5.15	3.18	1	10
Inhibit. – original	13	2.35	.57	1	3
Shift – original	13	2.00	.42	1	2
Emotional Control – original	13	2.15	.48	1	3
Initiate- original	13	2.00	.59	1	3
Working Memory– original	13	2.10	.51	1	3
Organization of materials– original	13	2.17	.67	1	3
Monitoring– original	13	2.22	.58	1	3
Plan/Organize– original	13	1.87	.32	1	2
MCI – original	13	2.07	.45	1	3
BRI – original	12	2.17	.47	1	3
GEC– original	12	2.10	.44	1	2
Inhibit. –new	12	2.30	.52	1	3
Shift – new	13	1.85	.40	1	2
Initiate– new	13	2.03	.53	1	3
Working Memory– new	13	2.01	.41	1	2
Organization of materials– new	13	2.17	.67	1	3
Monitoring– new	13	2.06	.62	1	3
MCI – new	13	2.08	.50	1	3
BRI – new	12	2.07	.45	1	3
GEC– new	12	2.06	.43	1	2

Table 20b D*escriptives posttest*

	N	*M*	*SD*	Min	Max
Total aggression	12	12.42	8.93	0	25
Reactive aggression	12	8.75	5.97	0	17
Proactive aggression	12	3.67	4.03	0	12
Inhibit. – original	13	2.09	.55	1	3
Shift – original	13	1.79	.56	1	3
Emotional Control – original	13	1.87	.60	1	3
Initiate- original	13	1.79	.52	1	3
Working Memory– original	13	1.88	.49	1	3
Organization of materials– original	13	2.13	.73	1	3
Monitoring– original	13	2.17	.56	1	3
Plan/Organize– original	12	1.81	.40	1	3
MCI – original	12	1.92	.46	1	3
BRI – original	13	1.92	.55	1	3
GEC– original	12	1.90	.46	1	3
Inhibit. –new	13	2.04	.57	1	3
Shift – new	13	1.76	.50	1	3
Initiate– new	13	1.79	.54	1	3
Working Memory– new	12	1.82	.44	1	3
Organization of materials– new	13	2.13	.73	1	3
Monitoring– new	13	2.23	.60	1	3
MCI – new	12	2.02	.53	1	3
BRI – new	13	1.86	.51	1	2
GEC– new	12	1.92	.47	1	2

Table 21 *Pre- and posttreatment comparisons of aggressive problems and executive functioning problems with effectsizes (r).*

Measure		*t*	*df*	*z*	*r*	*p*
RPQ	Total aggression	3.493	11		.73	.005**
	Reactive aggression	4.204	11		.79	.001**
	Proactive aggression			1.645		.100
BRIEF original	Inhibit			2.053	.42	.040*
	Shift			1.975	.39	.048*
	Emotional Control	2.432	12		.57	.032*
	Initiate	2.513	12		.59	.027*
	Working Memory	2.642	12		.61	.022*
	Organization of material	.415	12			.686
	Monitoring	.469	12			.648
	Plan/Organize	.526	12			.610
	MCI	1.800	11			.099
	BRI			2.434	.50	.015*
	GEC			2.124	.44	.033*
BRIEF new	Inhibition			2.606	.53	.009**
	Shift	1.168	12			.265
	Initiate	2.214	12		.54	.047*
	Working Memory	2.288	11		.57	.043*
	Organization of materials	.415	12			.686
	Monitoring	-1.354	12			.201
	MCI	.184	11			.875
	BRI			2.353	.48	.019*
	GEC			1.778		.075

* Significant at the 0.05 level (2-tailed). **Significant at the 0.01 level (2-tailed).

Table 22. *Factor Loadings for Exploratory Factor Analysis with Promax Rotation of the BRIEF-questionnaire* (*N =387)*

Item	Inhibition	Working memory	Shift	Organization of Materials	Initiate	Monitor
Heeft moeite een rem te zetten op zijn gedrag	**.806**	.421	.402		.403	
Reageert heftiger op situaties dan andere kinderen	**.765**	.318	.499		.360	
Heeft het niet in de gaten wanneer zijn gedrag negatieve reacties oproept	**.746**	.472			.437	
Kleine gebeurtenissen lokken grote reacties uit	**.738**		.423		.422	
Heeft niet in de gaten dat bepaalde gedragingen andere mensen storen	**.722**	.488	.308	.329	.448	.302
Gaat sneller door het lint dan vrienden	**.712**		.415			
Doet te wild of is onhandelbaar	**.704**	.333				
Praat op verkeerde momenten	**.703**	.427				
Heeft explosieve woedeaanvallen	**.697**	.321	.434		.380	
Heeft niet in de gaten wat het effect is van zijn gedrag en hoe anderen zich daaraan kunnen storen	**.693**	.530			.500	.300
Flapt er impulsief dingen uit	**.681**	.316				.301
Heeft woedeaanvallen om kleine dingen	**.677**		.438		.385	
Valt anderen in de rede	**.668**	.339			.307	
Humeur wordt gemakkelijk door de situatie beïnvloed	**.656**	.361	.372		.442	
Reageert overdreven op kleine problemen	**.630**		.433		.449	
Doet wilder of gekker dan anderen in groepen	**.622**	.356				
Woedeaanvallen of huilbuien zijn intensief, maar houden snel op	**.619**		.411		.376	
Staat op verkeerde momenten op van zijn stoel	**.612**	.416				
Verandert vaak van humeur	**.585**		.407		.405	
Doet domme dingen	**.561**	.376		.364		.390
Raakt in de problemen als er geen volwassene is die hem in de gaten houdt	**.558**	.472	.361		.423	
Heeft moeite om met huiswerk of karweitjes te beginnen	.370	**.790**		.400	.352	.421

(continued)

Table 22. *Factor Loadings for Exploratory Factor Analysis* (continued)

Item	Inhibition	Working memory	Shift	Organization of Materials	Initiate	Monitor
Heeft moeite zich te concentreren op karweitjes enz.	.372	**.786**		.419		.381
Heeft moeite om dingen af te maken	.436	**.781**		.477	.384	.358
Moet aangespoord worden om met een taak te beginnen		**.726**		.424	.368	
Heeft hulp nodig van een volwassene om bij de les te blijven	.494	**.711**	.408	.387	.357	.348
Kan zich maar kort concentreren	.429	**.699**		.413		.457
Onderschat de tijd die nodig is om taken af te krijgen	.347	**.695**		.324	.349	.328
Is snel afgeleid	.451	**.668**		.306	.309	.439
Heeft moeite dingen te doen die nodig zijn om zijn doelen te bereiken	.414	**.666**		.430	.308	.317
Begint pas op het laatste moment aana opdrachten of karweitjes	.376	**.648**		.456		
Heeft moeite met karweitjes of taken die meer dan een stap vereisen	.345	**.642**	.480	.518	.424	
Vergeet wat hij aan het doen was		**.638**	.380	.447	.322	
Vergeet het huiswerk in te leveren, ook als het af is		**.605**				
Denkt niet vooruit bij huiswerkopdrachten		**.587**			.302	
Heeft moeite dingen te onthouden, zelfs voor een paar minuten	.312	**.587**	.376	.366		
Als hij iets moet halen, vergeet hij wat het ook alweer was		**.582**	.380	.384		
Onthoudt alleen het eerste of het laatste als hij drie dingen te doen krijgt		**.582**	.351	.480	.337	
Raakt overweldigd door grote opgaven	.381	**.571**	.560		.460	
Heeft goede ideeen maar kan ze niet uitvoeren	.318	**.552**	.329	.333	.515	.302
Brengt huiswerk enz. niet mee naar huis		**.504**		.350		
Heeft goede ideeen, maar krijgt ze niet op papier	.339	**.436**	.326		.413	
Legt geen link tussen het doen van huiswerk en het behalen van cijfers		**.429**				
Begint niet uit zichzelf		**.418**		.301	.345	
Controleert zijn werk niet op fouten		**.392**				
Raakt van streek bij nieuwe situaties	.380		**.768**		.448	
Raakt van slag bij verandering van leraar of groep	.373		**.764**			
Raakt van streek als plannen gewijzigd worden	.390		**.753**		.349	
Raakt moeilijk gewend aan nieuwe situaties	.392	.306	**.744**		.424	

(continued)

Table 22. *Factor Loadings for Exploratory Factor Analysis* (continued)

Item	Inhibition	Working memory	Shift	Organization of Materials	Initiate	Monitor
Raakt verstrikt in details en verliest het algemene overzicht	.423	.567	**.619**	.307	.501	
Verzet zich tegen verandering van routine	.417		**.586**			
Raakt erg snel overstuur	.520		**.582**		.367	
Denkt te veel na over hetzelfde onderwerp			**.549**		.342	
Heeft een rommelige kamer		.380		**.797**		
Laat een spoor van eigendommen achter waar hij ook naartoe gaat		.462		**.785**		
Laat speelruimte rommelig achter		.438		**.781**		
Laat troep achter die anderen op moeten ruimen	.410	.531		**.764**	.306	
Heeft een rommelige kledingkast		.389		**.731**		
Kan dingen niet vinden in zijn kamer of op school	.327	.532		**.714**		
Heeft moeite om op ideeen te komen voor het spelen	.384	.331	.320		**.714**	
Heeft moeite iets met vrienden te ondernemen	.338		.392		**.700**	
Neemt geen initiatief		.427			**.680**	
Blijft een probleem op dezelfde manier benaderen	.496	.415	.358		**.582**	
Weigert of heeft moeite om een andere manier te accepteren om een probleem op te lossen	.496	.471	.342	.310	**.554**	
Hangt veel thuis					**.548**	
Kent eigen sterke en zwakke punten niet goed	.434	.411			**.519**	.316
Klaagt dat er niets te doen is	.446			.311	**.518**	
Huilt snel			.380		**.392**	
Geschreven werk ziet er slordig uit		.466		.330		**.848**
Zijn werk is slordig		.547		.432		**.820**
Heeft een moeilijk leesbaar handschrift		.378				**.800**
Maakt slordigheidsfouten		.570		.412		**.592**
Eigenvalues	15.655	16.108	9.250	9.379	9.995	6.177
% of variance	28.51	8.342	4.488	3.074	2.797	2.521
α	.94	.93	.85	.87	.80	.86

Discussion

This study investigated differences in executive functioning between individuals displaying proactive, and those displaying reactive aggression. Besides this, the effectiveness of the MBO intervention was evaluated in terms of decreases in aggressive and executive functioning problems. The factor structure of the Behavior Rating Inventory of Executive Functioning (BRIEF) was investigated, and yielded a new two-factor solution based on six subdomains. Predictor variables for reactive and proactive aggression were studied by means of both the original and new subscale divisions of the BRIEF. Predictors of reactive aggression, when controlled for proactive aggression, were found to be higher problem scores on both the Behavioral Regulation index, as well as the Metacognition index of both the original and the new factor structures of the BRIEF. Predictors of proactive aggression, when controlled for reactive aggression, were not found on index level. Predictors of reactive aggression on subscale level were found to be Emotional control of the original structure, and Inhibition and Organization of Materials of the new structure. For proactive aggression, Inhibition, Shift and Plan/Organize of the original subscales were found to be significant predictors. Of the new subscales, Inhibition and Shift were found to be predictors of proactive aggression when controlled for reactive aggression.

In addition, the CU trait Uncaring was found to be a predictor of reactive aggression after we controlled for proactive aggression. The CU traits Callousness and Uncaring were both found to be predictors of proactive aggression after controlling for reactive aggression. Introducing the CU traits into the models of executive functioning as predictors of aggression did not result in substantial differences.

Treatment effects of the MBO intervention were found for both aggression and executive functioning, with significant lower aggression scores for reactive individuals and a decrease in executive functioning problems.

Confirmatory factor analysis of the Behavior Rating Inventory of Executive Functioning

This study re-examined the underlying factor structure of the BRIEF for a normative sample of 387 adolescents. The findings supported a structure of the items into six instead of the proposed eight or nine subdomains (Gioia et al., 2000; Gioia et al., 2002; Egeland & Fallmyr, 2010; Huizinga & Smidts, 2011). These factors seem to be partly overlapping with the original eight subdomains of the Dutch version of the BRIEF. However, differences can be found in the item content of the subscales Inhibition, which seems to be formed by the original subscales Inhibit and Emotional Control, and Working Memory, which is largely built from the original subscales Working Memory and Plan/organize. The two newly formed composite scores are named the Behavioral Regulation index and the Metacognition index, although these new indices are not completely comparable to the original composite scores. An interesting difference is the subscale Initiate, which was originally part of the Metacognition index but within the new indices became part of the Behavioral Regulation index. Previous studies found the Monitor scale to consist of two distinct subscales resulting in a total of nine subscales with in some studies a three factor model (Gioia, Isquith, Retzlaff, & Espy, 2002; Huizinga & Smidts, 2011). Within a nine subscale division the subscale Self-Monitor loaded on the Behavioral Regulation Index while the subscale Task-Monitor was part of the MetaCognition Index. A separate third Index was formed by the subscales Shift and Emotional control resulting in a Emotion Regulation Index. Egeland and Fallmyr (2010) described the nine-subscale division as an opportunity to interpret the differentiation between an emotional and behavioral regulation component as the difference between cold and hot executive processes. In our study such a distinction between an emotional and behavioral component was not found and it seems that the Behavioral Regulation index comprises both elements. For example the questions that build up the Self-Monitor scale of the nine-division became in the current division part of the Inhibition subscale as well as the subscale Emotional Control. The current Monitor subscale therefore is built from the questions that formed the Task-Monitor subscale within the nine-division. Thereby this study emphasizes the need of further research in order to establish the differential validity of such a division as well as the need for comprehensive research on brain function and neuropsychological assessment. On the basis of the differences we found on the subscale and index levels we expected to find different predictive values of the original and new BRIEF structure as a measure of executive functioning.

Because of the analysis of the factor structure on both subdomains and composite level this study provides interesting new insights into the latent structure of the BRIEF. Most studies so far have investigated different factor models on composite level without providing insight into the latent structure on subdomain level. Our study indicates that a factor structure of six subscales is preferred above the eight subscale division for this particular sample of adolescents, and that these subscales should be interpreted as measuring two separate aspects of executive functioning. The high correlation between the two composite scores indicates a significant overlap between both indices, and hence supports the idea of treating executive functions as unities that are separate, but at the same time connected in an overarching executive system (Gioia, Isquith, Retzlaff, & Espy, 2002). The results of our study are in line with the finding of multidimensional structures of executive functioning in school-age children in previous research (Huizinga et al., 2006; Letho et al., 2003). Studies so far described executive functioning as a multifaceted construct more than an unitary model (Huizinga, et al., 2006; Miyake et al., 2000; Huizinga & Smidts, 2011). Current findings are in line with these studies although the outcome of the factor analysis also indicates that there is still no consensus about the content of the different executive functions, the underlying constructs and the interactions between these functions and constructs. Our findings thereby underline the complexity of measuring executive functioning.

Executive functioning and aggression

In line with our hypotheses, executive functioning problems were found to predict aggression. As expected, differences were found in the influence of executive functioning problems on reactive aggression as compared to this influence on proactive aggression, although executive functioning was found to be predictive for both reactive and proactive aggression. This latter result is in contrast with earlier research findings, because in most studies executive functioning was not found to be predictive of (proactive) aggression (Ellis et al., 2009; Van Goozen et al., 2004). This difference may be explained by our finding of a predictive value of separate executive functions on the subscale level for proactive aggression, whereas we did not find such a predictive value on a composite level. The only study on the influence of executive functioning on reactive and proactive aggression carried out so far is that by Ellis et al. (2009). They found deficits in executive functioning to be uniquely related to reactive aggression, and not to proactive aggression. However, their sample contained primary-school boys (mean age 10 years), while our sample consisted of secondary-school boys (mean age 14 years). Ellis and colleagues also used Dodge and Coie's *Teacher-Report* (1987) to assess proactive and reactive aggression, while for our study a self-report questionnaire was used. In addition, executive functioning was assessed by neuropsychological measures in the study by Ellis et al. (2009), measuring separate constructs (e.g., cognitive flexibility, planning ability, and response inhibition), while we assessed executive functioning on different levels by means of parent reports. As described earlier, executive functioning is thought to be developing during adolescence. The structural changes in the frontal cortex during adolescence that are thought to be explanatory for the age-related improvements in inhibitory control, working memory, and decision making could perhaps explain the contrasting findings (Hughes, 2011; Crone, 2009). The improvements expected in adolescent could possibly be less positive for children with aggressive behavior problems. Finding differences in the influence of executive functioning problems on reactive an proactive aggression in adolescence as compared to this influence in primary school boys as found by Ellis et al. (2009) could be an expression of the lack of improvement.

On subscale level we found Emotional Control of the original subscales and Inhibition and Organization of Materials of the new subscales to be predictive for reactive aggression. In both the original and new subscales we found Inhibition as a significant predictor of higher levels of proactive aggression, as well as Plan/organize of the original subscales. With regarding to the subscale Shift a negative predictive value was found, indicating that higher levels of problems on Shift may predict lower levels of proactive aggression. Our finding of a relatively better cognitive flexibility in proactive individuals is interesting in light of the BIS/BAS theory by Gray (1994), described earlier. We hypothesized that an overactive Behavioral Inhibition System may perhaps explain the more planned proactive subtype of aggression. In the study described here we found inhibition deficits in both reactive and proactive individuals. These results might suggest that inhibition is not the only mechanism leading to the necessary balance in BIS and BAS functioning; perhaps Shift is also such a mechanism. There may also be an interaction between inhibition and cognitive flexibility in proactive individuals with higher problems on cognitive flexibility leading to fewer problems in inhibition and visa versa. This interaction may explain why inhibition seems to have less predictive value on proactive aggression when compared to the predictive value on reactive aggression.

The different findings on subscale and composite level are also interesting in light of the discussion described earlier about the concept of executive functioning. As stated before, no consensus exists as to what executive functions are, how they are organized, or which test can be used in the assessment of the separate functions (Packwood et al., 2011). The results of our factor analyses can be seen as confirming the argument that with unravelling the underlying structure of executive functioning by factor analysis the cognitive processes are not automatically unravelled as well (Zelazo et al., 2003). As expected, on the basis of the factor analyses some differences were found between the predictive values of the original and the new divisions of the BRIEF on both subscale and composite level. We have seen that the different subscales can be characterized by different labels, and that the correlations between the subscales make it more difficult to describe them as separate executive functions. Important to mention is the predictive value of the original subscale Inhibit and the new subscale Inhibition. Although the content of the subscales slightly differ as explained before, both subscales had an important influence on both reactive and proactive aggression, and thereby these results provide additional evidence for the inclusion of inhibition problems in the diagnostic criteria of ODD.

The influence of the executive functioning deficits on reactive and proactive aggression differed, finding a larger amount of explained variance for the executive functioning problems on reactive aggression. Our findings of a relative small predictive value of executive functioning problems on proactive aggression indicate that other mechanisms could perhaps more explanatory for the differences between reactive and proactive individuals. The results of our study provide evidence for the validity of the distinction between reactive and proactive aggression and also suggest different underlying mechanisms for both subtypes. Finding a better executive functioning of proactive individuals as compared to those expressing mainly reactive aggression is in line with research carried out so far (e.g., Barrat et al., 1997; Villemarette-Pittman et al., 2002; Matthias et al., 2007).

More generally, our findings indicate that executive functioning problems can be seen as a predictor for reactive aggression at composite level, and for both reactive and proactive aggression on subdomain level. The value of executive functioning as a predictor of proactive aggression in terms of explained variance was half the predictive value for reactive aggression. Therefore, we interpret these findings in line with the study by Ellis et al., (2009), who also found difficulties in executive functioning (inhibition) to be related to a higher level of reactive aggression. However, we doubt the statement of Ellis and colleagues that executive functioning deficits seem to be uniquely related to reactive aggression. Our findings highlight the importance of doing more research in order to disentangle the differences between reactive and proactive aggression, and more specifically understand the role of neuropsychological factors in both subtypes.

Callous and Unemotional traits

As expected a relation was found between CU traits and both reactive and proactive aggression. The investigation of the predictive value of the three separate traits showed that only one of these was a significant predictor of reactive aggression after we controlled for proactive aggression, while both Callousness and Uncaring were found to predict proactive aggression after controlling for reactive aggression. These results are in line with our hypotheses concerning CU traits being closely related to proactive aggression. Introducing the CU traits into the models of executive functioning predicting aggression did not lead to substantial differences, which would indicate that CU traits do not have a mediating role within these models. Because CU traits are suggested to be the most important dimension for subtyping antisocial youth it is conspicuous that the influence of these traits can not be found for the predicting role of executive functioning although we did find differences between reactive an proactive individuals

(Marsee & Frick, 2010; Christian et al., 1997). Because CU traits are associated with more proactive aggression we expected to find an influence of these traits in the differences in executive functioning problems for reactive and proactive individuals. Perhaps a focus on the social, emotional, or affective differences between reactive and proactive aggressive individuals will help unravelling the differences in executive functioning between the subgroups and the influence of CU traits on these differences. We did not find an Emotional Index for the BRIEF, but previous research with nine subscales did find this index and differentiating between more Behavioral and Emotional components of executive functioning may unravel the role of CU traits (Egeland & Fallmyr, 2010). The lack of such an Emotional Index may also explain why we did not find an influence of the CU traits on the models of executive functioning predicting aggression. We were not able to make a clear distinction between executive functions with and without a motivational and emotional component. We expect that if such a distinction is made, differences will be found between reactive and proactive individuals with proactive individuals displaying higher levels of CU traits and a better ‘hot’ executive functioning as compared to reactive individuals (Principe et al., 2011; Van Goozen et al., 2004).

The strengths of this first part of our study are the relatively large sample size, which was especially important for the factor analyses conducted on the BRIEF; and the validation of the questionnaire on a normative sample, which ensures that this study can be seen as an important contribution to research on executive functioning. However, some limitations should be mentioned as well. First, our sample consisted of a group of 387 boys, without any girls being included. This may be seen as both a strength and a weakness of this study; on the one hand, it made the sample more homogeneous, with fewer cofounding variables that could have influenced our findings. On the other hand, for validation of the BRIEF it would have been worthwhile to include girls in the sample, because the implications of our results are only valid when the questionnaire is used for males. Second, because of a lack of descriptive information it was not possible to include more variables into the factor analyses in order to create subsamples of for example boys with and without clinical diagnosis. As a consequence we were not able to control for these variables in subsequent analyses. Using a sample of multiple clinical diagnoses has an advantage in that it allows for greater generalization to clinical populations at large and investigation in distinct clinical populations is necessary to further establish the construct validity of the BRIEF. However, exploratory factor analysis of the original eight subscale division showed the same two-factor solution in both clinical subjects and normal controls, therefore it can be argued that being unknown with possible diagnoses may not influence the outcomes of the exploratory factor analysis (Gioia et al., 2000). Thereby performing a confirmatory factor analysis with a mixed clinical and healthy sample has the advantage of maximum variability (Egeland & Fallmyr, 2010).

Treatment effect of the MBO intervention

We found the MBO intervention to be effective in reducing both aggression and executive functioning problems. A significant decrease in total aggression and reactive aggression was found, as well as a trend towards a decrease in proactive aggression. This trend was not significant, which may indicate that the intervention may be less effective for children displaying more proactive aggression. The effect sizes for decreases of reported aggression were high (effect sizes of .73 and .79), indicating a promising, reducing effect of the intervention on aggression. Significant decreases in executive functioning problems were found on the Behavioral regulation index of both the original and the new divisions of the BRIEF, and on the overall composite of the original BRIEF. On subscale level significant improvements in executive functioning were found with small to moderate effect sizes, with a mean effect size of .51 at post treatment. Because of the small sample we were not able to reliably correlate the improvements in executive functioning with decreases in aggression. The results of this study are promising especially because of the high effect sizes we found. Van de Wiel (2002) studied the effect of a variant of the MBO intervention, the Utrecht Coping Power Program (UCPP), and found effect sizes between .24 and .69. It seem that the MBO-intervention we studied is thereby more effective, but interpretation of the results should be done carefully and more research should be done to see if the effects we found can also be found in larger and more representative samples.

Some limitations of this second part of our study should be mentioned. First, the sample is relatively small, which results in less reliable findings. Second, because of the small sample we were not able to control for additional variables such as gender, socio-economic status, differences in intervention, or clinical diagnoses. Future research should consider these variables when investigating the effectiveness of the intervention and differences in treatment effects for proactive and reactive aggression. Another limitation is that we were not able to compare the MBO intervention with other interventions or with a non-treatment group. Judging from the reduction we found in both aggressive behavior problems and executive functioning problems, the intervention seems promising, but more studies are necessary to assess the effectiveness in larger samples and compare results to those of other or non-intervention groups.

Conclusion and implications

This study confirmed the existence of a distinction between reactive and proactive aggression. Differences were found regarding the predictive role of both executive functioning and CU traits for the two subtypes of aggression. The conceptualization of executive functioning seems to be important when the predictive value of executive functioning deficits for the two types of aggression is assessed. Although no relation has yet been found between the decrease in executive functioning and the decrease in aggression after participation in the MBO intervention, a focus on improving executive functioning in children and adolescents with aggression seems to be important because executive functioning is found to be a mechanism underlying both reactive and proactive aggression.

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