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Severe Aggressive Behavior

Towards understanding some of the underlying characteristics and treatment responsivity

Danique Smeijers
Severe Aggressive Behavior
Towards understanding some of the underlying characteristics and treatment responsivity

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Content

Chapter 1 General Introduction 7
Chapter 2 Generalized Hostile Interpretation Bias Regarding Facial Expressions: Characteristic of Pathological Aggressive Behavior 25
Chapter 3 Retrospective Parental Rejection is Associated with Aggressive Behavior as well as Cognitive Distortions in Forensic Psychiatric Outpatients 49
Chapter 4 Associations of Multiple Trauma Types and MAOA with Severe Aggressive Behavior and MAOA effects on Training Outcome 69
Chapter 5 Examining the Reactive Proactive Questionnaire in Adults in Forensic and Non-Forensic Settings: A Variable –and Person-Based Approach 91
Chapter 6 Correspondence Between the Reactive Proactive Questionnaire and the Impulsive Premeditated Aggression Scale among Forensic Psychiatric Outpatients 109
Chapter 7 Aggression Replacement Training among Aggressive Forensic Psychiatric Outpatients 131
Chapter 8 Associations between Neurocognitive Characteristics, Treatment Outcome and Drop-out among Aggressive Forensic Psychiatric Outpatients 153
Chapter 9 Discussion 177

Nederlandse samenvatting 195
Dankwoord 200
Curriculum Vitae 204
Donders Graduate School for Cognitive Neuroscience 206
Chapter 1

Introduction
Introduction

Watch out! And what are you looking at?! What do you want from me?!
Nothing... I did not look at you...
You did look at me and bumped into me deliberately!
I am sorry man I just tripped..
No you did not, admit it!

The situation escalates, the agitated person becomes furious and attacks the other person by hitting and kicking him. Eventually, he falls on the ground but this does not withhold the aggressive person from continuing the assault. It might be a relatively unexpected situation to become victim of violence. Unfortunately, such incidents happen quite often and, moreover, the aforementioned situation is just an example of all sorts of possible aggressive incidents. To experience as well as to witness such aggressive incidents is terrible but what about the offender? Does he act aggressively on purpose? Is aggression in his nature? What triggers such deviant behavior? How to decrease it? In other words, what are the characteristics and causes of disproportionate aggressive behavior? These questions are addressed in the current dissertation by reporting a series of studies. Before describing the main aims of this dissertation and its outline, I shortly review background information on aggression.

In general, aggression is defined as any behavior directed to another person, object or animal with the intention to cause harm (Anderson & Bushman, 2002). Aggressive behavior can be demonstrated verbally, physically, directed at oneself or others. In terms of psychopathology, several psychiatric disorders are characterized by anger and aggression such as the antisocial, borderline and narcissistic personality disorder and the intermittent explosive disorder. The antisocial personality disorder (ASPD) is characterized by a pervasive pattern of disregard for, and violation of, the rights of others. Aggressiveness is one of the core diagnostic criteria of ASPD which is often indicated by repeated physical fights or assaults (APA, 2000). The borderline personality disorder (BPD) is characterized by a pervasive pattern of instability in interpersonal relationships, self-image, and affects and impulsivity. Individuals with BPD often display inappropriate and intense anger or show difficulties in controlling anger which is indicated by for instance constant anger or recurrent physical fights (APA, 2000). The narcissistic personality disorder (NPD) is characterized by a pattern of grandiosity, need of admiration and lack of empathy (APA, 2000). A subgroup of individuals with NPD are thought to express behavior through interpersonally exploitative acts, such as aggression (Caligor, Levy, & Yeomans, 2015). Finally, the intermittent explosive disorder is characterized by the occurrence of discrete episodes of failure to resist aggressive impulses which result in serious verbal or physical treats or assaults or destruction of property (APA, 2000). The prevalence of these disorders is relatively high in the general population but is much higher in forensic psychiatric settings.

Irrespective the expression of aggressive behavior and related psychopathology, a further distinction is made based on aggression subtype. One of the most often made distinctions is the bimodal classification between reactive and proactive aggression. Reactive aggression refers to impulsive, angry or defensive responses to threat, frustration or provocation, whereas proactive aggression refers to deliberate behavior which is often driven by the obtainment of personal goals or gains (Crick & Dodge, 1996). These subtypes of aggression are thought to have different behavioral, emotional and neurobiological causes and consequences. Reactive aggression is associated with for instance poor social adjustment and emotion regulation, problems in peer-relations, and impairments in executive functioning whereas proactive aggressive behavior is linked to reduced emotional reactivity, low physiological arousal and lack of moral emotions (Babcock, Tharp, Sharp, Heppner, & Stanford, 2014; Cima & Raine, 2009; Polman, de Castro, Koops, van Bostel, & Merk, 2007). As the causes and consequences of reactive and proactive aggressive behavior are different, it is important to assess aggression subtype correctly. However, there is little consensus about which questionnaire or method can be used best to classify subtypes of aggression.

Now we have a definition of aggressive behavior, one might wonder why it is so important to pay special attention towards this phenomenon. First of all, aggression is considered to be an important societal issue with detrimental effects on victims, offenders themselves and even society in general (WHO, 2007). Each year, aggression cost more than a million victims worldwide. In 2014, in The Netherlands, 97,000 registered violent and sexual crimes and 134,000 registered crimes of destruction of property and against public order were committed (Kalieden & Lange, 2014). Furthermore, the victims of aggressive behavior are at higher risk for the development of psychological problems. The economic consequences of aggression are enormous due to social isolation, greater health-care and legal costs, absenteeism from work and lost productivity (WHO, 2007). Finally, aggressive behavior is the main reason for referral to forensic psychiatric settings. Considering the enormous health, social and economic consequences of aggression, there is a critical need for an enhanced understanding of the underlying causes and maintaining factors of aggressive behavior.

According to the Social Information Processing (SIP) model, it is thought that individuals with severe aggressive behavior have abnormal response repertoires in social situations due to modified information processing (Crick & Dodge, 1996). The SIP model consists
Introduction

The processing of social cues can be affected by dysfunctional beliefs, social schemas (Gagnon, McDuff, Daelman, & Fournier, 2015), or cognitive biases. For instance, the aggressive person described at the beginning of the general introduction suggested that the person he assaulted looked at him. One may wonder whether the aggressive person consciously observed the way that man looked at him, thought about it and responded accordingly or whether he interpreted the facial expression incorrectly, without any conscious reflection and responded to it impulsively. Based on the SIP model, the latter is more likely to be the case, due to deficits in the evaluation of social information. This phenomenon of an a-priory tendency to interpret facial expressions incorrectly and in a hostile manner is known as a hostile interpretation bias. This bias is considered to be an important cause as well as maintaining factor of aggressive behavior (Crick & Dodge, 1996; Schonenberg & Jusyte, 2014). Whether this bias is also displayed by patients in forensic mental health settings with severe aggressive behavior is yet unknown.

Furthermore, besides this cognitive factor, impulsivity is also considered to be associated with antisocial and aggressive behavior. Impulsivity is described as the inability to withhold a response or thought (inhibition), preference for immediate reward, acting without forethought, sensation-seeking and a tendency to engage in risky behavior (Bari & Robbins, 2013). The focus here is on response inhibition which is considered to be the neurocognitive underpinning of impulsivity. The ability to use cognitive capacities to inhibit impulsive actions is thought to be important for the progressing of individuals within human societies (Dambacher et al., 2014). Therefore, it is suggested that the right balance between impulsivity and inhibition is of extreme importance to self-control and successful development in a social environment. The failure of successful controlling impulsivity can lead to a variety of behavioral consequences such as aggressive reactions to provocation in social interaction (Dambacher et al., 2014).

Alongside neurocognitive factors, biological factors such as genetic factors might also play a role in the development or maintenance of aggressive behavior. One of the genes thoroughly studied regarding this association is the X-chromosomal MAOA gene, which encodes the enzyme monoamine oxidase A, responsible for the catabolism of dopamine, serotonin, as well as norepinephrine (Bortolato, Chen, & Shih, 2008; Veroude et al., 2016). The low activity variant of the MAOA gene is thought to be associated with reactive aggression (Buckholtz & Meyer-Lindenberg, 2008). Furthermore, it is thought that the interaction between the low activity variant of the MAOA gene and traumatic early life experiences increases the risk of later aggressive behavior (Buades-Rotger & Gallardo-Pujol, 2014; Caspi et al., 2002; Shiina, 2015; Sohrabi, 2015; Veroude et al., 2016). However, among prisoners this interaction effect is found regarding the high activity variant of the MAOA gene (Gorodetsky et al., 2014; Tikkanen et al., 2010). It is suggested that these prisoners may be an atypical group for MAOA effects on aggressive behavior (Gorodetsky et al., 2014). These prison samples are not in particular typified by disproportionate aggression and, therefore, this study provides no clear cut evidence on the interaction between adverse childhood events and genetic disposition as risk factors for severe aggressive behavior.

Subsequently, aside this interaction effect, a history of traumatic life events in itself is thought to contribute to antisocial and aggressive behavior (e.g. Kolla & Nigel Blackwood, 2013; Rehan, Sandnabba, Johansson, Westberg, & Santtila, 2015). Additionally, experiencing multiple trauma types is associated with even more chronic health and psychological problems than the experience of a single type of trauma (e.g. Agorastos et al., 2014; Finkelhor, Ormrod, & Turner, 2007a, 2007b; Grasso, Greene, & Ford, 2013). Related to early life experiences is also the relationship with ones parents and whether one perceives themselves as accepted or rejected by his/her parents. Specifically high levels of parental rejection, which is defined as high levels of hostility/aggression, undifferentiated rejection, and neglect and low levels of parental warmth, are associated with negative child developmental outcomes (Rohner, 2004). More specifically, there are indications that parental rejection is associated with the increased risk of aggressive behavior and that it could have a profound impact on the development of cognitive abilities that are necessary for appropriate regulation of behavior (e.g. Dykas & Cassidy, 2011; Shumaker, Deutsch, & Brennikmeyer, 2009). However, how the consequences of multiple types of trauma and perceived parental rejection are related to severe adult aggressive behavior is largely unexplored.

The multiplicity of factors associated with the emergence, development and maintenance of aggressive behavior suggest that aggression is complex behavior involving many different processes. Additionally, these factors may all be associated with each other which makes it even more difficult to comprehend. In the following section the General Aggression Model (GAM) which will be explained. This model is one of the few models which tries to explain the many different factors and processes involved in aggressive behavior.
The General Aggression Model

To understand aggressive behavior the General Aggression Model (GAM) incorporates biological, personality, social and cognitive factors as well as learning history and decision and appraisal processes (Anderson & Bushman, 2002; DeWall, Anderson, & Bushman, 2011). These processes are described in three stages: 1) person and situations inputs, 2) present internal state (cognition, arousal, affect), and 3) outcome of appraisal and decision processes. The schematic representation of the GAM is displayed in Figure 1.

The GAM starts with an input level consisting of situational and personal causes. Situational causes include characteristics of the present environment that inhibit or increase the likelihood of an aggressive act, such as provocation, an insult or the presence of a weapon. Personal causes are characteristics of the individual such as personality traits, behavioral tendencies and cognitive biases. These “input variables”, independent from each other or interactively, affect an individual’s behavior through the second stage of the model: the present internal state. The influence of the input variables may be on one, several or all factors of the present internal state. This influence might be direct or indirect. Subsequently, the factors in this second stage affect each other reciprocally. Finally, the third stage of the GAM consists of several complex appraisal and decision processes. Results from the input variables enter into this third stage through their influence on the present internal state. The processes of the third stage occur relative automatic which is called “immediate appraisal” or range from more to heavily controlled which is labeled as “reappraisal”. Immediate appraisal is relatively spontaneous, effortless, occurs without awareness and includes goal, intention and affective information. The content of immediate appraisal is determined by the present mental stage, the second stage of the GAM. It is dependent of two factors whether reappraisal occurs: 1) availability of resources (e.g. no sufficient mental resources to engage in reappraisal processes) and 2) the immediate appraisal is judged as important but unsatisfactory. Is one of these criteria met then impulsive actions occur. In case reappraisal occurs, a search will be activated in order to find an alternative view of the situation. During the process of reappraisal many cycles might occur; eventually a thoughtful course of action occurs. This action might be non-aggressive as well as aggressive. The final action cycles through the social encounter to become part of the input for the next episode.

The GAM considers each episodic cycle as a learning trial. The development of an “aggressive personality” (i.e. an individual who is highly likely to use aggression) is the result of series of learning trials that prepare someone to behave aggressively in various situations. Furthermore, the risk for aggressive behavior is also determined by biological predispositions such as genetics and executive functioning deficits. These factors manifest themselves through interaction with the social context in which an individual develops. Examples of such social/environmental modifiers are insecure attachment, parental rejection and traumatic events. Such interactions allow biological predispositions to affect social behavior by influencing knowledge structures (e.g. scripts, schemas, beliefs) and affecting the effective component of these knowledge structures. Important knowledge structures are: 1) perceptual schemata: are used to identify everyday physical objects as well as complex social events; 2) person schemata: include beliefs about a particular person; and 3) behavioral schemata: contain information about how people behave under various circumstances.

![Figure 1. The General Aggression Model](image)
In sum, aggressive behavior consists of a complex interplay between factors of different levels within the individual and even in interaction with the environment as well. Considering the enormous health, social and economic consequences of aggression, there is a critical need for a better understanding of these underlying causes and maintaining factors as well as of effective treatments of maladaptive aggressive behavior. It is conceivable that these characteristics might also be associated with responsivity to treatment or treatment drop-out. For instance, one may wonder whether individuals with a high disposition to act aggressively benefit most or less from treatment, whether certain deficits in social information processing are altered enough or whether individuals with a specific aggression subtype are more likely to drop-out. Before elucidating these issues, the subsequent section first describes how aggressive behavior is treated nowadays.

Treatment of Aggressive Behavior
Anger management is often used to treat anger and aggressive behavior. It focuses on gaining recognition of the psychological causes of one’s anger and to manage anger appropriately (Schamborg & Tully, 2015). Another example of interventions used in forensic settings to treat aggressive behavior is psychomotor therapy. During psychomotor therapy the focus is on the physiological component of aggression. Patients learn to recognize bodily sensations as component of anger and aggression, learn to handle them efficiently and to gain more control (Zwets et al., 2016). However, generally, interventions based on principles of cognitive behavioral therapy (CBT) are the interventions of first choice in treating anger and aggression (Henwood, Chou, & Browne, 2015; Lipsey, Chapman, & Landenberger, 2001). The CBT is based on the idea that thought distortions play a central role in the development and maintenance of maladaptive behavior. Techniques from behavioral as well as cognitive therapy are combined. Cognitive therapy focuses on the influence of thoughts on behavior and emotions. Behavior therapy, on the other hand, focuses on maladaptive behavior and the development of adaptive behavioral patterns. Techniques from behavior therapy, such as role-play, exposure and behavioral experiments, are used to examine the validity of dysfunctional cognitions and to practice new ways of coping. A larger variety of interventions, either in groups or individually, used to treat aggressive behavior are based on the principles of CBT and may or may not be combined with the aforementioned anger management or psychomotor therapy. One of the current most frequently used CBT-based interventions to treat aggressive behavior is the Aggression Replacement Training (ART, Brännström, Kaunitz, Andershed, South, & Smedslund, 2016).

Aggression Replacement Training (ART)
The ART is a multimodal intervention, originally developed for use in children and adolescents, but nowadays also used among adults even though there is no evidence base for it yet. The developers of the ART believe that aggressive behavior is associated with limited social skills, inadequate emotion and aggression control and a lack of pro-social norms and values (Glick & Goldstein, 1987; Goldstein, Glick, & Gibbs, 1998). Therefore, the ART consists of three modules:

1) **Social skills training** which focuses on responding in a pro-social way to difficult situations instead of using aggression, for instance by learning to say “no” in a socially adequate way.

2) **Anger control training** which learns techniques to exert more control over aggressive thoughts and aggressive impulses, for instance by increasing insight in internal and external triggers and learning to take a time-out.

3) **Moral reasoning training** where patients learn to recognize certain cognitive distortions related to aggression and think in less egocentric ways by means of group discussions.

When an individual is diagnosed with aggression regulation problems, one is highly likely to receive ART or a similar intervention, either in groups or individually, as an “one size fits all” intervention. In general, the ART is considered to be an effective intervention even though there are also inconsistent results (Brännström et al., 2016). The effectiveness of the ART among adults and among individuals with severe aggression, however, is clearly understudied. Previous studies regarding the effectiveness of the ART have been mainly focused on child and adolescent samples. In addition, studies that are conducted among adult populations, consisted of heterogeneous samples (Brännström et al., 2016) including violent offenders, individuals convicted for crimes like robbery and even offenders with a history of psychosis. Results from these kinds of studies do not provide clear cut evidence for the effectiveness of the ART on, specifically, aggressive behavior in adults. Considering the wide spread use of interventions like the ART, there is a critical need to explore its effectiveness in specific populations. Furthermore, as aforementioned, aggressive behavior consists of a complex interplay between various factors. It is conceivable that treatment responsivity or treatment drop-out is associated with these characteristics. Therefore, it is of great importance to elucidate which characteristics are associated with treatment outcome and to investigate for which subgroup of individuals this treatment is suitable. This knowledge would enable forensic clinical practice to develop personalized treatment which may enhance treatment adherence, reduce drop-out rates and improve the effectiveness.
The Current Dissertation

This dissertation consists of a large treatment study among forensic psychiatric outpatients with severe aggressive behavior. The overall aim of this dissertation is to elucidate underlying causes and maintaining factors of disproportionate aggressive behavior. In different studies I investigated whether the following, aforementioned, factors are associated with severe adult aggressive behavior: hostile interpretation bias towards emotional facial expression, neurocognitive characteristics such as impulsivity, the low activity variant of the MAOA gene, multiple types of trauma and perceived parental rejection. A schematic representation of the characteristics investigated in the current dissertation is provided in Figure 2. The characteristics which are examined are all part of the GAM and are considered to be personal and biological factors as well as environmental modifiers. The next aim of this dissertation is to examine which of these characteristics were associated with treatment outcome and drop-out. Another aim is to investigate the applicability and correspondence between the most frequently used questionnaires to assess aggression subtype.

Sample and Design

The sample which is investigated in the current dissertation consists of adult forensic psychiatric outpatients (FPOs) with aggression regulation problems. Referral to a forensic psychiatric outpatient clinic occurs either obligatory (e.g. when sentenced by a judge) or voluntary (based on reference by general practitioner). All FPOs are referred to the outpatient clinic because of aggression regulation problems. Aggression could be demonstrated verbally, physically, directed at the FPO self or others and as general violence or domestic violence. To participate in the study, FPOs are required to meet each of the following criteria:

1) a diagnosis of an antisocial, borderline and/or narcissistic personality disorder, and/or the intermittent explosive disorder (IED)
2) a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS)

In addition, FPOs are excluded if there is a current major depression, current severe addiction or lifetime bipolar disorder or psychosis. All these in- and exclusion criteria are screened before the start of treatment. Once FPOs are suitable for participation they proceeded with the baseline measurement which is completed before the start of their treatment. All FPOs were treated with the Aggression Replacement Training (ART) either in groups or individually. Besides ART for general aggression and violence, ART is also offered for perpetrators of intimate partner violence. This version of the ART is identical to the regular ART, except that the partners of the FPOs are involved during this intervention. Halfway, after 6 weeks, the level of aggressive behavior is determined again by use of the SDAS. An end of treatment measurement takes place after 12 weeks. Figure 3 provides an overview of the study design.

The final sample consists of 169 FPOs of which 115 also participated in the end of treatment measurement. Fifty-eight (34.32 %) FPOs dropped out of participation due to no show during treatment, death, reference to another treatment or because they were not willing to participate anymore. Figure 4 shows the complete recruitment process and drop-out rates.
**Measures**

In order to measure the underlying causes and maintaining factors various measurements are employed: interviews, self-report questionnaires, neurocognitive computer tasks, and saliva collection. Semi structured interviews have been used to examine the inclusion and exclusion criteria and to verify diagnoses. Self-report questionnaires have been used to measure factors such as aggression subtype and severity, early life events and parental rejection. To measure improvement in aggressive behavior a questionnaire is also administered to the FPOs therapist in order to avoid a possible lack of retrospective abilities or social desirability by FPOs. The neurocognitive computer paradigms focus on underlying thoughts, attitudes and memory, i.e. mental abilities which are less conscious and more automatically in nature such as impulsivity and cognitive biases. Besides the fact that these tasks are able to measure automatic attitudes and behavioral dispositions, they are also less easy to control deliberately and have, for the participant, less transparent purposes. Finally, saliva collection will be used as non-invasive method to collect DNA for genotyping.

![Figure 3. Study design](image)

![Figure 4. Recruitment process and drop-out rates](image)
Outline Of This Dissertation

The underlying factors of aggressive behavior among FPOs are elucidated in chapters 2, 3, and 4. In chapter 2 a study is presented in which as task (Hostile Interpretation Bias Task) is developed in order to examine a hostile interpretation bias which is considered as a personal factor. This refers to an a-priori tendency to, automatically, interpret emotional facial expressions as hostile. Exhibiting such a bias affects social information processing negatively. The study in chapter 2 provides evidence for this hostile interpretation bias being a characteristic of maladaptive aggressive behavior. Chapter 3 describes the complex interplay between an environmental modifier and aggressive behavior. This chapter is devoted to early contributing factors in the development of aggression. A study is presented in which the impact of retrospective parental rejection on current aggressive behavior is described. Finally, chapter 4 focuses on both biological causes as well as environmental modifiers. The study in chapter 4 is about the impact of MAOA genotype and traumata and reveals the complexity of using these factors to explain aggressive behavior.

In addition, a first step is taken to elucidate which subgroup of individuals benefit most from treatment as the study in chapter 4 also assesses whether there is an association between a genetic predisposition and treatment outcome. Subsequently, apart from the GAM, chapters 5 and 6 are about the measurement of aggression subtype. Whether an aggressive act is impulsive or deliberate in nature may seem easy to determine, however, there is little consensus about which questionnaire can be used best to classify aggressive behavior. The most frequently used questionnaires to assess the bimodal classification, which are often used interchangeably, are the Reactive Proactive Questionnaire (RPQ) and the Impulsive Premeditated Aggression Scale (IPAS), developed for use in adults. Chapter 5 is about the applicability of the RPQ among adults whereas chapter 6 focuses on the correspondence between the RPQ and the IPAS. Chapter 7 and 8 are devoted to the evaluation of the social skills and anger control modules of the ART among FPOs. In chapter 7 a study is presented which focuses on self-report measurements whereas chapter 8 focuses on neurocognitive paradigms. In both chapter 7 and 8, the focus is on the associations between aggression characteristics and treatment outcome as well as personality and individual differences in order to elucidate to which subgroup of individuals this intervention is most suitable. The final chapter of this dissertation, chapter 9, provides a summary of the main findings of each chapter. Explanations are described on how the revealed causes and maintaining factors result in an enhanced tendency to act aggressively. Furthermore, the responsivity to treatment is questioned and the clinical implications as well as future directions are discussed.

References


Introduction


Chapter 2

Generalized Hostile Interpretation Bias Regarding Facial Expressions: A Characteristic of Pathological Aggressive Behavior

Abstract

Individuals with aggression regulation disorders tend to attribute hostility to others in socially ambiguous situations. Previous research suggests that this “hostile attribution bias” is a powerful cause of aggression. Facial expressions form important cues in the appreciation of others’ intentions. Furthermore, accurate processing of facial expressions is fundamental to normal socialization. However, research on interpretation biases in facial affect is limited. It is asserted that a hostile interpretation bias (HIB) is likely to be displayed by individuals with an antisocial (ASPD) and borderline personality disorder (BPD) and probably also with an intermittent explosive disorder (IED). However, there is little knowledge to what extent this bias is displayed by each of these patient groups. The present study investigated whether a HIB regarding emotional facial expressions was displayed by forensic psychiatric outpatients (FPOs) and whether it was associated with ASPD and BPD in general or, more specifically, with a disposition to react with pathological aggression. Participants of five different groups were recruited: FPOs with ASPD, BPD, or IED, non-forensic patients with BPD (nFPOs-BPD), and healthy, non-aggressive controls (HCs). Results suggest that solely FPOs with ASPD, BPD, or IED exhibit a HIB regarding emotional facial expressions. Moreover, this bias was associated with type and severity of aggression, trait aggression, and cognitive distortions. The results suggest that a HIB regarding facial expressions is an important characteristic of pathological aggressive behavior. Interventions that modify the HIB might help to reduce the recurrence of aggression.

Introduction

Facial expressions

An important aspect of social interaction is facial expression. Facial expressions carry a broad range of socially relevant information: They give information regarding the internal states of the sender and they provide important cues for our impressions of others (Moriya, Tanno, & Sugiura, 2012; Schonenberg & Jusyte, 2014). Accurate processing of facial expressions is critical to normal socialization and social interaction (Moriya et al., 2012). However, in everyday life, situations are not always straightforward and often consist of ambiguous information. Likewise, people do not necessarily express prototypical expressions; subtle facial expressions are often displayed instead (Moriya et al., 2012). This renders it even more difficult to process facial expressions correctly. Furthermore, associated with psychopathology, some individuals lack the ability to process facial affect accurately. For instance, antisocial personality and psychopathic traits have been associated with deficits in the recognition of facial affect (Dawel, O’Kearney, McKone, & Palermo, 2012; Dolan & Fullam, 2006; Marsh & Blair, 2008). However, incorrect recognition may not solely be based on impairments in emotion recognition; it might also arise from an a-priori tendency to interpret facial expression in a certain way, regardless of the ability to recognize the expression correctly. In this case, we speak of an interpretation bias.

Hostility biases

Apart from the processing of facial expression of others, aggressive behavior has been suggested to occur after making a hostile attribution that “the self” has been threatened (Dodge, 2006). This tendency of aggressive individuals to perceive or attribute hostile intent to others is often referred to as “hostile attribution bias” (Nasby, Hayden, & DePaulo, 1980). Reactive aggressive behavior is thought to be associated with this hostile attribution bias, in children as well as in adults; higher levels of this bias were associated with higher levels of aggressive behavior (Bailey & Ostrov, 2007; Chen, Coccaro, & Jacobson, 2012; Crick, 1995; Crick & Dodge, 1996; Crick, Grotpeter, & Bigbee, 2002; De Castro, Veerman, Koops, Bosch, & Monschouwer, 2002; Dodge, 2006). Reactive aggression is defined as an impulsive, angry, or defensive response to threat, provocation, or frustration (Crick & Dodge, 1996), and occurs in response to particular social situations. Furthermore, these studies suggest that aggressive individuals tend to attribute hostility to others in socially ambiguous situations. This attribution of hostility can have detrimental effects, as the perception of aggressive intent in others is a powerful cause of anger and aggressive behavior (Epstein & Taylor, 1967). Moreover, hostile attribution biases not only cause and predict aggressive acts (Dodge, Bates, & Pettit, 1990), they also contribute to the maintenance of aggression. When attributing hostile intents to others, one is more
likely to act aggressively, which in turn causes others to respond more aggressively, which will further strengthen the person's hostile view of others (Crick & Dodge, 1996; Helfritz-Sinville & Stanford, 2014).

Previous studies, which revealed the existence of hostile attribution biases, solely made use of vignettes, using videos or written stories. The vignettes describe hypothetical situations in which someone is provoked by a peer who is acting ambiguously. Participants are asked to indicate the intention of the peer. Research showed that a hostile attribution bias occurs in these ambiguous situations. With regard to this aspect of hostile biases, vignettes are suitable materials. However, as stated earlier, facial expressions play an important role in social situations and may also induce aggressive intentions and behavior when not processed or interpreted accurately. It is possible that this hostile bias not only occurs in the attribution of others' intentions in ambiguous situations, but also with respect to the interpretation of ambiguous facial expressions. However, the method of vignettes omits the possible role of facial expression in a hostile interpretation bias (HIB).

Until now, only a few studies have investigated interpretation biases regarding facial expressions. Hoaken, Allaby, and Earle (2007) have observed that violent offenders, compared to non-violent offenders and healthy controls, were likely to interpret a neutral face less often as sad and more frequently as disgusted. Another study revealed that an attributional bias towards “negative facial affect” was associated with aggressiveness in institutionalized boys (Nasby et al., 1980). Burt, Mikolajewski, and Larson (2009) showed that trait aggression was moderately associated with hostile perceptions of others' neutral facial expressions. Schonenberg and Jusyte (2014) recently investigated the HIB toward ambiguous facial cues in antisocial violent offenders. They used pictures of emotional faces (angry, happy and fearful) and morphed them with each other, creating three dimensions: happy – fearful, happy-angry and fearful – angry. They created five distinct intensity levels. Their results suggest that antisocial violent offenders infer hostile intent from the angry-happy and angry-fearful morphs. The authors conclude that aggressive individuals interpret ambiguous facial cues as hostile and showed a tendency to overrate the perceived intensity of anger. However, the morphed pictures all consisted of two emotions shown simultaneously. Even though these stimuli are ambivalent, in everyday life, these emotions are rarely displayed together.

Previous studies of biases assume that rating a picture as angry suggests that the person also interprets it as hostile. This notion suggests that anger and hostility are interchangeable. However, “angry” and “hostile” differ in meaning (Eckhardt, Norlander, & Deffenbacher, 2004). Anger can be referred to as an emotional state and constellation of specific uncomfortable subjective experiences and associated cognitions, whereas hostility can be described as an attitude that involves dislike and negative evaluation of others (Eckhardt et al., 2004). To our knowledge, it is unknown whether individuals interpret only an angry face as hostile. It could be that other emotions such as disgust are also experienced as hostile. In addition, none of the previous studies asked participants to indicate whether they experienced a certain picture as hostile.

**Hostility biases and psychopathology**

In addition to the general population samples tested in previous research, a hostile attribution/interpretation bias was also found in a few studies of populations displaying pathological forms of aggressive behavior (Lobbestael, Cima, & Arntz, 2013; Schonenberg & Jusyte, 2014). Pathological aggression, here, is defined as aggressive behavior which is disproportionate to the provocation (Siever, 2008). Pathological aggression is a characteristic feature of antisocial personality disorder (ASPD), borderline personality disorder (BPD) and intermittent explosive disorder (IED). These two latter disorders were less intensively studied regarding hostile attribution/interpretation biases, although they seem to be as relevant as ASPD.

Borderline personality disorder (BPD) is characterized by inappropriate and intense anger or difficulty controlling anger (APA, 2000). Patients diagnosed with BPD are highly likely to display maladaptive cognitive processes (Baer, Peters, Eisenlohr-Moul, Geiger, & Sauer, 2012). For instance, borderline patients tend to believe that other individuals are more hostile, aggressive, untrustworthy, and dangerous (Arntz, Weertman, & Salet, 2011; Baer et al., 2012; Fertuck, Grinband, & Stanley, 2013). Furthermore, associations have been found with attentional biases towards negative emotional stimuli and with rejection- and anger-related interpretation of ambiguous social situations (Baer et al., 2012; Lobbestael & McNally, 2015). With respect to facial expressions, borderline patients are thought to interpret neutral or ambiguous facial expressions more negatively and to exhibit deficits in the recognition of emotional facial expressions, in particular regarding faces displaying anger and disgust (Diaros, Zakzanis, & Ruocco, 2013). Previous literature seems to suggest that BPD is as much associated with aggression and hostile interpretation biases as ASPD. This raises the question whether a HIB is a characteristic of ASPD and BPD in general.

When recurrent episodes of failure to resist aggressive impulses are the main characteristic of a patient, without clear evidence for a personality disorder, IED may be the most appropriate diagnosis (APA, 2000). Even though this disorder is not as persistent as personality disorders, its behavioral patterns may have as many detrimental consequences. IED has not been related to cognitive and hostility biases as frequently as
ASPD and BPD. Nevertheless, one of the few studies regarding this topic showed that individuals with IED exhibit deficits in emotional intelligence (Coccaro, Solis, Fanning, & Lee, 2015). It is assumed that emotional intelligence is related to the ability to understand and recognize emotional information of oneself and others, and to use this information to guide thoughts, actions and coping mechanisms (Coccaro et al., 2015; Mayer & Salovey, 1993). Furthermore, this deficit was found to be associated with hostile cognitions as well as hostile attributions to others' intentions in socially ambiguous situations. Coccaro et al. (2015) suggest that a deficit in emotional intelligence facilitates the tendency to make hostile attributions about others' intentions. These results suggest that IED is as likely to be associated with a HIB as ASPD and BPD are.

According to previous literature a HIB is associated with reactive aggression and is likely to be displayed by individuals diagnosed with ASPD as well as BPD, and probably also those with IED. However, to our knowledge, there are no studies regarding hostility biases in which these psychiatric disorders were investigated simultaneously. Unraveling whether hostility biases are associated with general or pathological aggression or specific psychiatric disorders might be of particular importance for clinical practice. Treatment for aggression is based on whether or not there is a personality disorder. One variant generally consists of developing skills to control anger, often used in less profound disorders. Cognitive therapeutic interventions, on top of skill training, may be used in treatment variants often used among patients with personality disorders, for instance to alter cognitive distortions. As a HIB may be a powerful cause and maintaining factor of aggressive behavior, it may have to be reduced/changed in interventions for even less persistent and profound disorders, such as IED, as well. Until now, there is little knowledge about the extent to which this bias is specifically displayed by patients with ASPD, BPD or IED.

Current study

The aims of the present study, therefore, were twofold. First, we aimed to validate a newly developed test to investigate the presence of a HIB with respect to facial expressions. This HIB test consisted of a computer task in which facial pictures displaying emotions of various intensities were presented. The pictures displayed the following emotions: anger, happiness, fear, and disgust. To create different intensities, pictures were morphed with neutral pictures in order to avoid images showing multiple emotions simultaneously and to let the expressions be more similar to expressions displayed in daily life. Although the morphed pictures ranged from neutral to full emotion, they exhibited a certain degree of ambiguity; the neutral expression was in all models displayed with mouth closed whereas the emotional pictures where displayed with mouth open. This difference in mouth position resulted in pictures showing ambiguous expressions. Moreover, instead of asking participants to indicate which emotion was shown or to indicate the intensity of the emotion, participants were asked to indicate whether the picture looked hostile or not. Furthermore, previous research mainly focused on the link between hostile attribution/interpretation bias and reactive vs. proactive aggression. To be able to discover a possible association between HIB and type and severity of aggression and conscious cognitive distortions, a number of questionnaires were administered.

The second aim was to investigate whether a HIB regarding emotional facial expressions is specifically associated with ASPD, or with both ASPD and BPD or, more specifically, with pathological aggressive behavior. Participants from five different groups were recruited: forensic psychiatric outpatients (FPOs) diagnosed with ASPD, BPD, or IED, non-forensic borderline patients with BPD (nFPOs-BPD), and healthy, non-aggressive controls (HCs). It was predicted that all groups of FPOs would show a HIB. Specifically, in line with the work of Schonenberg and Jusyte (2014), we predicted that FPOs would interpret low intensity, ambiguous facial expressions more often as hostile than HCs would. In addition, it was predicted that nFPOs-BPD would also exhibit a greater HIB towards facial expressions than HCs.

Methods

Participants

One-hundred-forty-two FPOs, 23 nFPOs-BPD of a general mental health institute and 47 HCs were recruited for the study. The FPOs were recruited from a series of patients admitted to “Kairos, Pompestichting”, an outpatient clinic for forensic psychiatry at Nijmegen, The Netherlands. The nFPOs-BPD were recruited at the department of psychiatry of Radboud University Medical Center, Nijmegen, the Netherlands. They were referred to a dialectical behavior therapy, which is a comprehensive and evidence-based treatment for BPD (Linehan, 2013). They were diagnosed with BPD by trained clinicians at the department of psychiatry. The HCs were recruited via online postings on the clinic’s website.

To exclude participants with a diagnosis of a lifetime bipolar disorder, psychosis, current major depression, or current severe addiction, all participants were screened with the MINI International Neuropsychiatric Interview (M.I.N.I; Sheehan et al., 1998; Van Vliet & De Beurs, 2007). None of the nFPOs-BPD and HCs, and only two of the FPOs had to be excluded due to a current major depression.
The FPOs were screened by trained clinicians with the Structured Clinical Interview for DSM-IV axis II personality disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000) and the Research Criteria set for Intermittent Explosive Disorder (IED-R; Coccaro, Kavoussi, Berman, & Lish, 1998). For the purpose of the current study, solely FPOs diagnosed with either ASPD, BPD or IED were included. 33 FPOs had to be excluded due to co-occurrence of these disorders. Therefore, the final current sample of FPOs consisted of 40 patients diagnosed with ASPD, 30 with BPD, and 37 with IED without ASPD or BPD. All FPOs were referred to the outpatient clinic because of aggression regulation problems. In the present study, 82 patients were referred voluntarily and 25 obligatory.

Both the FPOs and the nFPOs-BPD participated before the start of their treatment. After receiving information about the nature of the study, participants signed a consent form. Demographic information is provided in Table 1. In total, it took participants approximately 50 minutes to complete the assessments. All participants were compensated for their time with an appropriate monetary reward. Moreover, the current study was approved by the Research Ethics Committee, CMO region Arnhem-Nijmegen, The Netherlands.

Materials

Questionnaires

The Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990) is an observer-scale that measures the severity of actual aggressive behavior. It consists of nine items measuring outward aggression and two items measuring inward aggression. Items have to be scored on a 4-point scale with 0 = not present and 4 = severely to extremely present as extremes. The SDAS has adequate observer reliability (Cronbach’s Alpha = .79; Wistedt et al., 1990). In the current study, due to lack of observers, the SDAS was used as self-report. Participants had to rate their aggressive behavior over a period of three months. Moreover, only FPOs with a total SDAS score of five points or higher were included in the study.

The Reactive Proactive Questionnaire (RPQ; Cima, Raine, Meesters, & Popma, 2013; Raine et al., 2006) is a 23-item self-report questionnaire to measure reactive and proactive aggression. The reactive subscale consists of 11 items whereas the proactive subscale consists of 12 items. The items are rated 0 (never), 1 (sometimes) or 2 (often). The Dutch translation has good internal consistency (Cronbach’s Alpha = .91) and adequate convergent (all r < .16), criterion (delinquents from prison and forensic mental health scored higher than non-offenders) and construct validity (violent offenders show more proactive aggression than non-offenders, p < .001; Cima et al., 2013). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha = .92).

The Aggression Questionnaire (AQ; Buss & Perry, 1992) is a self-report questionnaire to assess an overall trait of aggression. It consists of 29 items which are divided into four subscales: physical aggression, verbal aggression, anger and hostility. The items are scored on a 5-point Likert scale (1 = extremely unlike me to 5 = extremely like me). The

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>FPOs ASPD</th>
<th>FPOs IED</th>
<th>FPOs BPD</th>
<th>nFPOs BPD</th>
<th>HC’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>M = 34.32 (SD = 9.31)</td>
<td>M = 34.08 (SD = 12.37)</td>
<td>M = 36.30 (SD = 10.99)</td>
<td>M = 34.83 (SD = 8.89)</td>
<td>M = 38.06 (SD = 13.29)</td>
</tr>
<tr>
<td>Male</td>
<td>N = 41</td>
<td>N = 37</td>
<td>N = 24</td>
<td>N = 15</td>
<td>N = 27</td>
</tr>
<tr>
<td>Female</td>
<td>N = 0</td>
<td>N = 0</td>
<td>N = 6</td>
<td>N = 8</td>
<td>N = 20</td>
</tr>
<tr>
<td>IQ*</td>
<td>M = 89.85a,b (SD = 11.25)</td>
<td>M = 89.85a,b (SD = 11.25)</td>
<td>M = 88.83a,b (SD = 11.70)</td>
<td>M = 95.43a,b (SD = 10.72)</td>
<td>M = 100.18a (SD = 11.89)</td>
</tr>
<tr>
<td>Weekly alcohol use</td>
<td>M = 9.63 (SD = 23.53)</td>
<td>M = 4.49 (SD = 7.55)</td>
<td>M = 5.21 (SD = 10.16)</td>
<td>M = 1.65 (SD = 2.48)</td>
<td>M = 5.91 (SD = 7.47)</td>
</tr>
<tr>
<td>Weekly cannabis use</td>
<td>M = 6.24 (SD = 22.43)</td>
<td>M = 5.4 (SD = 2.42)</td>
<td>M = 4.10 (SD = 10.74)</td>
<td>M = 7.4 (SD = 2.07)</td>
<td>M = 12.02 (SD = 15.05)</td>
</tr>
<tr>
<td>AQ*</td>
<td>M = 95.85c (SD = 13.84)</td>
<td>M = 80.80 (SD = 17.05)</td>
<td>M = 99.80 (SD = 16.58)</td>
<td>M = 77.35a (SD = 12.46)</td>
<td>M = 57.83 (SD = 10.38)</td>
</tr>
<tr>
<td>NFT total</td>
<td>M = 25.73c (SD = 6.30)</td>
<td>M = 20.76c (SD = 5.74)</td>
<td>M = 23.73c (SD = 7.65)</td>
<td>M = 17.10c (SD = 4.47)</td>
<td>M = 17.10c (SD = 4.47)</td>
</tr>
<tr>
<td>Proactive aggression (RPQ)</td>
<td>M = 5.80c (SD = 3.85)</td>
<td>M = 2.16c (SD = 5.29)</td>
<td>M = 3.83 (SD = 3.53)</td>
<td>M = 1.65c (SD = 1.95)</td>
<td>M = .72c (SD = 1.27)</td>
</tr>
<tr>
<td>SDAS total</td>
<td>M = 15.10 (SD = 5.96)</td>
<td>M = 12.57 (SD = 7.32)</td>
<td>M = 18.87 (SD = 6.83)</td>
<td>M = 6.10 (SD = 2.46)</td>
<td>M = 2.85 (SD = 2.36)</td>
</tr>
</tbody>
</table>

*as measured by using the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1993). Note: Superscripts of mean values indicate significant group differences: Groups with different superscripts differ from each other at least p<.05.
The task consisted of a practice block and two experimental blocks. The practice block consisted of 16 trials (8 models x 2 emotions). Only pictures with happy and angry affect and of 100% intensity were used to familiarize participants with the task. Each experimental block consisted of 168 trials (8 models x 4 emotions x 5 intensity levels + 8 neutral images). The order of the pictures was randomized and equal in both blocks and equal to every participant. Participants were instructed to indicate whether the picture looked hostile or not. In case they thought they saw a hostile picture, they were asked to press the Z-key, otherwise the M-key (on a qwerty keyboard). They had to respond as quickly as possible. The picture, size 8.5 cm x 10.5 cm, was presented for four seconds, in the center of the computer screen, against a black background. The pictures remained on the screen until a response was given or until four seconds had passed. The time period of four seconds was chosen to let participants both observe the picture and respond based on their impulses. After a pretrial pause of one second, a new picture was displayed immediately. Labels were displayed in the left (Yes, hostile) and right (No, not hostile) bottom corner of the screen in white Arial font, size 30. Responses given by pressing the Z-key, indicating that the participant saw a hostile picture, were defined as “hostile” responses. If a response was not given within four seconds, the words “Too late” appeared on the screen in red. A hostile interpretation bias was defined as the percentage of “hostile” responses to the emotional pictures. The hostile responses were dummy coded (0 = no, not hostile, 1 = yes, hostile), and the mean was calculated: this immediately revealed the percentage of the pictures that were interpreted as hostile. Trials without a response (due to late responding) were not taken into account. In total, it took participants approximately 10 minutes to complete the HIBT.

Furthermore, the HIBT was used in a small pilot study (N = 22) in which forensic psychiatric inpatients were assessed. These patients were all diagnosed with antisocial personality disorder and did not participate in the current study. In this pilot study, the HIBT was administered twice with a one-week interval. The correlations of the two measurements for angry, fear, happy, and disgust were $r = .774, p < .001; r = .904, p < .001; r = .295, p = .822; r = .908, p < .001$, respectively. These results suggest good test-retest reliability, except for faces displaying happy affect.

Dutch translation has adequate psychometric properties (Cronbach’s Alpha = .86; Morren & Meesters, 2002). In the present study the internal consistency has also proven to be good (Cronbach’s Alpha = .93).

The How I Think questionnaire (HIT; Barriga & Gibbs, 1996) is a 54-item self-report questionnaire to assess self-serving cognitive distortions. The items are divided into four cognitive distortion subscales (self-centered, blaming others, minimizing/labeling, assuming the worst) and four behavioral referent categories (physical aggression, opposition-defiance, lying, stealing). Items have to be answered on a 6-point Likert scale (1=totally agree to 6=totally disagree). The Dutch translation has proven reliability (Cronbach’s Alpha ranged from .90 to .94) and validity (all $r < .20$; Nas, Brugman, & Koops, 2008). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha = .94).

**Hostile Interpretation Bias Task**

The Hostile Interpretation Bias Task (HIBT) was developed to assess a HIB. Photos of faces with emotional affect (angry, fear, disgust, happy) of four male and four female models were selected from the Radboud Faces Database (Langner et al., 2010). Each affective picture was morphed (using WinMorph 3.01) five times with the neutral image of the same individual, creating 20%, 40%, 60%, 80% and 100% emotion intensity, respectively. The neutral expression was in all models displayed with mouth closed whereas the emotional pictures were displayed with mouth open. This difference in mouth opening resulted in pictures showing ambiguous expressions. An example is displayed in Figure 1.

![Figure 1. Example of morphed emotional facial expressions](image-url)
Results

Hostile Interpretation Bias and Pathological Aggression

Group differences on HIB

The mean percentage of “hostile” responses per intensity and emotion is displayed in Figure 2. To analyze whether FPOs (ASPD, IED, BPD) show a different pattern of hostile interpretation than nFPOs-BPD and HCs, an overall omnibus test was conducted with a 4 (emotion: anger, happy, fear, disgust) x 5 (intensity: 20%, 40%, 60%, 80%, 100%) x 5 (group: ASPD vs. IED vs. BPD vs. nFPOs-BPD vs. HCs) repeated-measures design. Due to violation of sphericity, Greenhouse-Geisser correction was used. Significant main effects of emotion, intensity, and group were found, $F(2.43, 417.11) = 415.41, p < .001, \eta^2 = .707; F(30.37, 1305.89) = 220.42, p < .001, \eta^2 = .562$, respectively. The emotion x group and emotion x intensity x group interactions did reach significance, $F(9.70, 417.11) = 1.284, p = .127, \eta^2 = .042$; and $F(7.59, 1305.89) = 2.59, p = .012, \eta^2 = .003$, respectively. These results indicate that the interpretation of hostility differed for each emotion and intensity. Faces displaying anger and disgust were interpreted as hostile more often than expressions with fear or happy affect (mean percentage “hostile” responses; anger: 52.89%; disgust: 45.57%; fear: 21.58%; happy: 7.51%). Moreover, happy faces were the least interpreted as hostile. Regarding intensity, Figure 2 illustrates that for angry, disgust, and fearful expressions, “hostile” interpretations increased with increasing intensity of the emotion, whereas the opposite was true for expressions of happiness. The results also suggest that FPOs (ASPD, IED, BPD), nFPOs- BPD, and HCs differed in their overall level of perceived hostility and in their patterns of hostile interpretations of emotional facial expressions. There was a significant difference between the FPOs (ASPD, IED, BPD), nFPOs-BPD, and HCs for IQ and gender (see Table 1). To analyze whether IQ and gender were confounding variables, the analysis described above was conducted again, now with IQ as a covariate and gender as an additional between-subjects factor. Results showed that the effect sizes did not differ essentially when IQ and gender were taken into account. It was also revealed that IQ was not associated with the frequency of “hostile” responses, whereas gender was, $F(1, 166) = 2.29, p = .131, \eta^2 = .014; F(1, 166) = 5.27, p = .024, \eta^2 = .03$, respectively. Therefore, in subsequent analyses only gender was included as an additional between-subjects factor.

Group differences on HIB per emotion

As the previous analysis revealed an interaction effect between emotion and group, four different 5 (intensity: 20%, 40%, 60%, 80%, 100%) x 5 (group: ASPD vs. IED vs. BPD vs. nFPOs-BPD vs. HCs) x 2 gender (male, female) repeated-measures ANOVAs were conducted, one for each emotion, to analyze more specifically on which emotions FPOs (ASPD, IED, BPD), nFPOs-BPD, and HCs differed. Due to violation of sphericity, Greenhouse-Geisser correction was used. To control for multiple comparisons, Bonferroni correction was used in all subsequent analyses. There were significant main effects of intensity and group for anger, $F(2.26, 382.37) = 275.17, p < .001, \eta^2 = .62; and F(4, 169) = 3.34, p = .012, \eta^2 = .073$, respectively. The intensity x group interaction was non-significant: $F(9.05, 382.37) = .71, p = .700, \eta^2 = .017$. Gender was not a significant covariate: $F(1, 169) = 1.88, p = .173, \eta^2 = .011$.
The same was found for disgust: Significant main effects of intensity and group were observed, $F(2,58, 385.87) = 113.38, p < .001, \eta^2 = .42$; and $F(4, 169) = 4.40, p = .022, \eta^2 = .094$, respectively. The intensity x group interaction was not significant, $F(9,13, 385.87) = 1.37, p = .197, \eta^2 = .031$. Gender did function as a significant covariate, $F(1, 169) = 4.09, p = .045, \eta^2 = .024$.

There were significant main effects of intensity and group for fear, $F(1,92, 324.55) = 16.54, p < .001, \eta^2 = .089$; and $F(4, 169) = 7.15, p < .001, \eta^2 = .145$, respectively. The intensity x group interaction also reached significance: $F(7,68, 324.55) = 2.23, p = .027, \eta^2 = .05$. Gender was a significant covariate: $F(1, 169) = 5.75, p = .018, \eta^2 = .033$.

For happiness, significant main effects of intensity and group were found again: $F(2.55, 431.71) = 26.75, p < .001, \eta^2 = .137$; and $F(4, 169) = 3.58, p = .008, \eta^2 = .078$, respectively. The intensity x group interaction also reached significance: $F(10.22, 431.71) = 2.17, p = .018, \eta^2 = .049$. Gender did not function as a significant covariate: $F(1, 169) = 2.07, p = .152, \eta^2 = .012$.

Taken together, these results indicate that angry, disgusted and fearful pictures of higher intensity were more often interpreted as hostile whereas high intensities of happiness were interpreted as less hostile than low intensities. Moreover, gender only functioned as a significant moderator for the interpretation of fearful and disgusted faces. However, even here the main effect of group remained significant. In addition, group-wise comparisons indicated that FPOs (ASPD, BPD, IED) differed from HCs on all four emotional expressions (anger: $p = .046$; happy: $p = .006$; fear: $p < .001$; disgust: $p = .004$). FPOs differed from nFPOs-BPD solely on faces displaying anger or fear (anger: $p = .034$; fear: $p = .007$). The nFPOs-BPD did not differ from HCs on any of the emotions. In addition, the three groups of FPOs did not differ from each other on any of the emotions.

Correlations between HIB and questionnaires

To explore the associations between HIB and type and severity of aggression, trait aggression, and cognitive distortions, correlational analyses were performed on the full sample. The two subscales of the RPQ and the total scores of the other questionnaires were of interest in the current analyses. The correlation between the raw mean reactive and raw mean proactive score of the RPQ was high ($r = .75, CI = .69 - .80, p < .001$). Therefore, the residualized measures of both subscales were created in order to assess the correlates of reactive and proactive aggression independently of one another, as suggested by Raine et al. (2006) and Cima et al. (2013). Reactive aggression was regressed on proactive scores and Pearson standardized residuals (with a mean of 0 and SD of 1) were saved to index residualized proactive aggression, while the standardized residuals of proactive aggression on reactive aggression were saved to index residualized reactive aggression.

Correlations were computed using the percentage of “hostile” responses per emotion condition, averaging across intensities. To determine confidence intervals and to test the significance of the correlations, a bootstrapping (1000 samples) procedure was used. Bootstrapping is based on random sampling with replacement. It simulates the population distribution of the correlation and to provides confidence intervals for the correlation coefficients (Sideridis & Simos, 2010). When using this approach a more accurate estimate of the associations is provided than estimates produced by a single sample (Hesterberg, Monaghan, Moore, Clipson, & Epstein, 2003).}

Table 2. Correlations between HIB and questionnaires.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>HIB Angry faces</th>
<th>HIB Happy faces</th>
<th>HIB Fearful faces</th>
<th>HIB Disgusted faces</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQ total</td>
<td>$r = 0.219$</td>
<td>$r = 0.201$</td>
<td>$r = 0.182$</td>
<td>$r = 0.186$</td>
</tr>
<tr>
<td></td>
<td>CI = 0.072 - 0.365</td>
<td>CI = 0.042 - 0.354</td>
<td>CI = 0.031 - 0.322</td>
<td>CI = 0.040 - 0.121</td>
</tr>
<tr>
<td></td>
<td>p = 0.041</td>
<td>p = 0.007</td>
<td>p = 0.016</td>
<td>p = 0.014</td>
</tr>
<tr>
<td>HIT total</td>
<td>$r = 0.176$</td>
<td>$r = 0.206$</td>
<td>$r = 0.203$</td>
<td>$r = 0.172$</td>
</tr>
<tr>
<td></td>
<td>CI = 0.008 - 0.345</td>
<td>CI = 0.145 - 0.432</td>
<td>CI = 0.069 - 0.335</td>
<td>CI = 0.023 - 0.128</td>
</tr>
<tr>
<td></td>
<td>p = 0.053</td>
<td>p = 0.001</td>
<td>p = 0.007</td>
<td>p = 0.022</td>
</tr>
<tr>
<td>Residual proactive aggr.</td>
<td>n.s</td>
<td>n.s</td>
<td>n.s</td>
<td>n.s</td>
</tr>
<tr>
<td>Residual reactive aggr.</td>
<td>n.s</td>
<td>n.s</td>
<td>$r = 0.162$</td>
<td>$r = 0.212$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CI = 0.017 - 0.299</td>
<td>CI = 0.071 - 0.344</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>p = 0.032</td>
<td>p = 0.005</td>
</tr>
<tr>
<td>SDAS total</td>
<td>$r = 0.193$</td>
<td>$r = 0.263$</td>
<td>$r = 0.256$</td>
<td>$r = 0.222$</td>
</tr>
<tr>
<td></td>
<td>CI = 0.064 - 0.323</td>
<td>CI = 0.090 - 0.416</td>
<td>CI = 0.104 - 0.389</td>
<td>CI = 0.084 - 0.354</td>
</tr>
<tr>
<td></td>
<td>p = 0.016</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.003</td>
</tr>
</tbody>
</table>

Note: n.s. refers to non significant.
Group differences on questionnaires
As the correlational analysis revealed that there was an association between a HIB regarding facial expressions and type and severity of aggression, and cognitive distortions, a MANOVA was conducted to investigate whether FPOs differed in these characteristics from nFPOs-BPD and HCs. Means are displayed in Table 1. Bonferroni correction was used to control for multiple comparisons. A significant multivariate effect of group was found, Wilks’ Lambda = .280, F(20, 554.83) = 12.96, p < .001, \( \eta^2 = .272 \). Separate univariate ANOVAs showed significant group differences for total AQ score, total HIT score, proactive aggression (RPQ), reactive aggression (RPQ), and total SDAS score: F(4, 175) = 55.73, \( p < .001 \), \( \eta^2 = .566 \); F(4, 175) = 25.59, \( p < .001 \), \( \eta^2 = .375 \); F(4, 175) = 20.34, \( p < .001 \), \( \eta^2 = .322 \); F(4, 175) = 38.85, \( p < .001 \), \( \eta^2 = .475 \); and F(4, 175) = 57.95, \( p < .001 \), \( \eta^2 = .574 \), respectively. These results showed that FPOs with ASPD and BPD had a higher disposition to act aggressively, they had higher levels of cognitive distortions, proactive aggression and reactive aggression, and they showed aggressive behavior more frequently than nFPOs-BPD and HCs. The FPOs with IED displayed similar scores on all questionnaires as the nFPOs-BPD, except for the SDAS. The nFPOs-BPD showed more aggressive behavior, except reactive aggression, than HCs (see Table 1).

Discussion
The current study found a highly generalized HIB to facial expressions among FPOs diagnosed with ASPD, BPD, or IED, rather than nFPOs- BPD and HCs. The present findings are in agreement with those of Schonenberg and Jusyte (2014), who found that antisocial violent offenders interpreted ambiguous facial cues as hostile. Previous studies suggested that aggressive individuals tend to attribute hostility to others in socially ambiguous situations (Bailey & Ostrov, 2007; Crick, 1995; Crick et al., 2002; De Castro et al., 2002; Dodge, 2006; Lobbestaelf et al., 2013). Together with the study by Schonenberg and Jusyte (2014), the current research provides support for the idea that a hostile attribution bias exists not only regarding ambiguous social situations, but also with respect to ambiguous and less ambiguous facial expressions.

Overall, a significant effect of intensity was found; as the intensity of facial expressions displaying anger, disgust or fear increased, expressions were more often interpreted as hostile. These results indicate that the interpretation bias of hostility is not limited to angry expressions, as may have been suggested by previous studies. This intensity effect of disgusted faces was also found among HCs. Disgust and contempt look very similar. However, disgust is often displayed regarding objects, whereas contempt relates more to people. Perhaps disgust is misinterpreted as contempt and therefore experienced as hostile. Additionally, it is also conceivable that anger and disgust are confused with each other based on the similarities between these expressions (Wieser & Brosch, 2012). The influence of contextual cues on the processing of facial expressions is considered to be significant (Wieser & Brosch, 2012). As the current task only presented facial expressions without any contextual cues, it is possible that faces displaying anger and disgust were evaluated alike. The intensity effect of fear, on the other hand, may be explained in terms of recognition deficits, as antisocial behavior was associated with deficits in the recognition of fearful facial affect (Marsh & Blair, 2008). It might be suggested that FPOs process fearful expressions incorrectly and therefore display biased interpretations. The intensity effect was reversed for happy faces; as the intensity increased, the faces were less often interpreted as hostile. This is plausible as happy faces are probably experienced as more positive and therefore as less hostile.

In line with previous research, which suggested that aggressive individuals attribute hostility to others in socially ambiguous situations, it was predicted that FPOs only differed in interpretation of hostility for more ambiguous facial expressions (40%, 60%, 80%) and not in the least ambiguous pictures with 20% or 100% intensity of the facial expression. The current results, however, revealed that FPOs exhibited a comparable pattern of HIB across all intensity levels. This indicates that FPOs interpret not only ambiguous expressions, but emotional facial expressions in general as hostile.

It was revealed that all FPOs displayed more “hostile” responses to angry, disgusted, fearful, and happy facial expressions than HCs did. The FPOs interpreted faces displaying anger or disgust more often as hostile than nFPOs-BPD. No differences were found between responses on the HIBT between nFPOs-BPD and HCs. Based on previous literature, which suggested that ASPD, BPD and IED all are likely to exhibit cognitive and interpretation biases, it was predicted that not only the FPOs would show a HIB, but also the nFPOs- BPD. Although the nFPOs-BPD consisted of a group of psychiatric patients receiving intensive treatment, they performed surprisingly similar to the HCs on the HIBT. As both the FPOs and nFPOs- BPD were assessed before the start of their treatment, possible treatment effects on this hostility bias were ruled out. The present findings strongly suggest that the FPOs generally tend to interpret various emotions, at every intensity level, more frequently as hostile than nFPOs-BPD or HCs do. The FPOs exhibited much higher levels of aggressive behavior, the findings lend support to the notion that a HIB regarding facial expressions is a characteristic of pathological aggression, typically shown in forensic settings, regardless of a psychiatric diagnosis of ASPD, BPD, or IED.
Previous studies have shown that there was an association between hostility biases and reactive aggressive behavior (Bailey & Ostrov, 2007; Chen et al., 2012; Crick, 1995; Crick et al., 2002; De Castro et al., 2002; Dodge, 2006; Lobbestael et al., 2013). In accordance with these studies, the current study revealed an association with reactive aggression. The correlation, however, only occurred for faces displaying fear and disgust. No link was observed with proactive aggression. Clear associations were found between the overall HIB and severity of aggressive behavior and for the overall trait of aggression. This might be explained by the high levels of aggressive behavior, in general, displayed by the FPOs; not only higher levels of reactive and proactive aggression and trait aggression were displayed by FPOs with ASPD and BPD than nFPOs-BPD and HCs, but also more severe aggressive behavior was shown by all three groups of FPOs, that is, they showed more pathological forms of aggressive behavior. The current results underline the idea that individuals with aggression regulation problems, in real life, have an increased disposition to respond aggressively to ambiguous situations as well as to ambiguous and less ambiguous facial expressions.

A HIB was also found to be associated with another clinically relevant characteristic: self-serving cognitive distortions. It is well known that cognitive distortions are related to violent and aggressive behavior (Chereji, Pintea, & David, 2012). However, the present study is one of the first to show a link between conscious self-serving cognitive distortions and a more implicit HIB regarding emotional facial expressions. The current result underlined the external validity of the HIBT. In addition, this finding might suggest the notion of a general predisposition in FPOs to display cognitive biases, whether it is conscious or more automatically. This association needs to be studied in further detail. It underlines the necessity to not only alter conscious cognitive distortions but to also focus on automatic biases in order to reduce aggressive behavior.

The current findings may have some implications with respect to forensic clinical practice. The HIB might be the result of a failure to learn how to make a benign interpretation, or due to deficits in the evaluation and appraisal of situations, as is suggested by the Developmental Model of Hostile Attribution Style, the Social Information-Processing Model, and the General Aggression Model (Crick & Dodge, 1994; DeWall, Anderson, & Bushman, 2012; Dodge, 2006). The current results emphasize the need to determine the presence of this bias in order to reduce it in all variants of interventions. Besides developing skills to control anger, FPOs need to become aware of their automatic tendency to interpret facial expressions as hostile and to learn how to interpret facial expressions differently and more accurately.

The present study and has a number of limitations which merit further comment. First, except for the HIBT, all measurements consisted of self-report. It is questionable whether a population of FPOs is fully able to reflect on their own behavior and whether they are willing to answer genuinely. Second, a HIB may be closely related to deficits in facial emotion recognition. Regarding prospective research, it would be interesting to include an emotion recognition task to explore its associations with a bias in the interpretation of facial affect. Third, it would be of great importance to include another task with a different response format. Hence, it would be possible to exclude any response bias which may have occurred in the current study, as the FPOs tended to show more “yes” responses. Fourth, it may be possible that FPOs are better at detecting potential threat and might, therefore, interpret angry and disgusted faces correctly as hostile instead of displaying a bias. More research, however, is needed to explore this possibility. Fifth, in the current task only facial expressions displaying anger, fear, disgust, and happiness were selected. For future research, it will be necessary to include other emotional facial expressions to investigate the generalizability of this hostility bias. Sixth, the non-forensic group consisted solely of patients with BPD, and the sample size of this group was rather small. The gender distribution varied in the different groups, and women were underrepresented overall (59.2%). The results, therefore, are most applicable to male individuals. Future research using larger samples should replicate the current findings.

Notwithstanding the limitations, this study revealed the existence of a generalized HIB of emotional facial expressions which is highly likely to be a characteristic of pathological aggressive behavior displayed by FPOs. Future research could investigate the causality of the association between pathological aggressive behavior and HIB. At present there are multiple types of hostility biases that have been identified by very different paradigms of which the hostile attribution bias is the most widely researched version. Our HIB and also the hostile expectation bias found by Bushman and Anderson (2002), are other examples of hostility biases. All these biases have been repeatedly found to be associated with higher levels of aggressive, violent and antisocial behavior. To date, however, there is no evidence on whether these biases are distinct phenomena or whether they are manifestations of the same underlying construct, this will be an important avenue for future research. Subsequently, more knowledge is needed on how to reduce these biases successfully. Previous research showed that it was possible to modify biases in emotion recognition and to improve facial affect recognition after a brief computerized training (Penton-Voak et al., 2013; Schönenberg et al., 2014). It would be of great interest to assess whether these techniques are able to reduce a general HIB. In the long run, interventions that alter the HIB might even help to reduce the recurrence of aggression.
References


Hostile Interpretation Bias and Pathological Aggression


Chapter 3

Retrospective Parental Rejection is Associated with Aggressive Behavior as well as Cognitive Distortions in Forensic Psychiatric Outpatients

Smeijers, D., Brazil, I., Bulten, E., & Verkes, R.J. Retrospective Parental Rejection is Associated with Aggressive Behavior as well as Cognitive Distortions in Forensic Psychiatric Outpatients. (Revision submitted).
Abstract

Objective: Parental rejection in childhood is associated with the increased risk of aggression in adulthood and is thought to contribute to the development of inaccurate beliefs regarding own or others’ behavior (i.e., cognitive distortion) as well. Different forms of aggression are thought to be linked to different types of cognitive distortions. This, however, is unclear in adults. Additionally, it is unknown if parental rejection predicts the presence of aggression and cognitive distortions in adults displaying severe aggression.

Method: One hundred twenty-three adult forensic psychiatric outpatients diagnosed with aggression regulation problems were recruited. Least absolute shrinkage and selection operator (Lasso) regression analysis and path analyses were conducted to investigate distinct patterns of cognitive distortions and the role of perceived parental rejection.

Results: The results suggest that cognitive distortions related to opposition-defiance (e.g. disrespecting rules) and to physical aggression were most strongly associated with the disposition to act aggressively. Furthermore, a direct association was found between parental rejection and this current disposition. This association was partially mediated by cognitive distortions related to opposition-defiance.

Conclusion: The current study supports the notion that parental rejection has profound consequences on adult behavior. Acknowledgement of the impact of cognitive distortions on current aggression might be of importance for treatment. More focus on altering distinct cognitive distortions may be more successful in reducing aggression.

Introduction

Severe or enduring negative experiences with parents during childhood may have long-lasting detrimental effects, such as disturbed psychological functioning later in life. According to the Parental Acceptance and Rejection Theory, low parental acceptance and high parental rejection are related to negative child developmental outcomes (Rohner, 2004). Parental rejection is defined in terms of high levels of hostility/aggression, undifferentiated rejection, and neglect and low levels of parental warmth. The opposite is true for parental acceptance. Parental rejection could be a cause of insecure attachment, as attachment is based on an infant’s information about the caregivers tendency to be responsive, available, and sensitive to the infant’s needs (Dykas & Cassidy, 2011).

Previous studies have shown that parental rejection and insecure attachment are associated with the increased risk of aggressive behavior, hostility, criminality, violence in childhood, in adolescence and also in adulthood (Brendgen, Vitaro, Tremblay, & Lavoie, 2004; Eron, Huesmann, & Zelli, 1991; Gallarin & Alonso-Arbiol, 2012; Khaleque & Rohner, 2012; Leary, Tvenge, & Quinlivan, 2006; Rohner, 2016; Savage, 2014). Furthermore, there are indications that factors such as insecure attachment and parental rejection could have a profound impact on the development of cognitive abilities that are necessary for appropriate regulation of (social) behavior (for a review see Dykas & Cassidy, 2013; Shumaker, Deutsch, & Brenninkmeyer, 2009). More specifically, attachment security is thought to facilitate reflective capacities and social understanding (Fonagy & Target, 1997). Insecure attachment and parental rejection on the other hand are associated with cognitive distortions (Cassidy, Kirsh, Scolton, & Parke, 1996; Dodge, 1993; Rohner, 2016; Shumaker et al., 2009). Cognitive distortions are defined as inaccurate attitudes, thoughts or beliefs regarding own or others’ behavior (Barriga & Gibbs, 1996). A possible explanation of the development of cognitive distortions is provided by the developmental model of hostile attribution style proposed by Dodge (2006). This model holds that hostile attribution biases are universally acquired in early life and that, usually, children learn to make benign attributions. However, some children fail to develop the skills to make benign attributions of non-hostile situations. One of the experiences in early life that might contribute to this failure is a lack of warmth between caregiver and infant (Dodge, 2006). Generally, cognitive distortions are thought to lead to problematic functioning, distorted communications, and negative expectations about others’ behavior (Cassidy et al., 1996; Dodge, 1993; Dykas & Cassidy, 2011; Shumaker et al., 2009).

Furthermore, cognitive distortions could lead directly to the disposition to show severe aggressive behavior (Shumaker et al., 2009). Inappropriate aggressive and antisocial
Parental Rejection, Aggression and Distorted Cognition

behavior may be strengthened or maintained by cognitive distortions, that may have a function in protecting a positive self-image, and neutralizing feelings of blame and guilt (Barriga, Hawkins, & Camelia, 2008; Barriga, Landau, Stinson, Liau, & Gibbs, 2000). Due to this self-serving role, cognitive distortions of aggressive or antisocial individuals are often referred to as self-serving cognitive distortions. Furthermore, it is thought that different forms of aggression are related to distinct sets of distorted cognitions in youth. Barriga et al. (2008) reported that a disposition to use physical aggression was associated with self-serving cognitive distortions particularly related to physical aggression (e.g. “people need to be roughed up once in a while”, “if people don’t cooperate with me, it’s not my fault if someone gets hurt”), whereas verbally aggressive behavior was related to self-serving cognitive distortions related to opposition-defiance (e.g. “rules are mostly meant for other people”, “if I really want to do something, I don’t care if it’s legal or not”). It was suggested that aggressive behavior is not characterized by generic cognitive distortions. Furthermore, it was proposed that these different cognitive distortions could contribute to personalized-treatment by focusing on altering cognitive distortions corresponding to a specific type of aggression.

Taken together, previous studies indicate that parental rejection could increase the risk of aggressive behavior and could have an influence on the development of cognitive distortions as well whereas self-serving cognitive distortions are also directly associated with aggression. In addition, a recent study by de Vries, Hoeve, Stams, and Asscher (2015) demonstrated that the link between attachment and aggressive behavior is mediated by self-serving cognitive distortions in adolescents. As parental rejection could also lead to insecure attachment, a similar negative association may also be found between aggression and parental rejection. De Vries et al. (2015) focused on adolescents at risk or already involved with criminal behavior, but who did not commonly engage in excessively aggressive behavior. In violent adults, this link has not yet been investigated. Importantly, previous studies on parental rejection and cognitive distortions mainly included community samples that were not typified by clinical levels of aggressive behavior. It is also unknown whether the association between parental rejection and severe aggressive behavior is related to distinct patterns of self-serving cognitive distortions in aggressive adults. Therefore, disentangling the association between parental rejection, severe aggressive behavior and self-serving cognitive distortions will significantly advance our understanding of the developmental factors promoting aggressive behavior which also may be beneficial for treatment.

The goals of the present study were two-fold. 1) First, we investigated which self-serving cognitive distortions were associated with aggressive behavior in an adult sample displaying pathological aggressive behavior, namely in a population of forensic psychiatric outpatients (FPOs) with aggression regulation problems. 2) Second, the association between perceived parental rejection, aggression, and self-serving cognitive distortions in this severely aggressive population was explored. Based on Barriga et al. (2008), it was hypothesized that aggressive behavior displayed by FPOs was associated with cognitive distortions related to physical aggression and opposition-defiance. Moreover, in line with De Vries et al. (2015), a direct link between parental rejection and aggression as well as a mediating link, via cognitive distortions, was expected. In specific, it was hypothesized that higher levels of perceived parental rejection were associated with higher levels of aggressive behavior as well as self-serving cognitive distortions.

Methods

Participants

One hundred twenty-three male forensic psychiatric outpatients (FPOs) with aggression regulation problems participated in the study (see Table 3 for demographic information). The FPOs were recruited among patients admitted to “Kairos”, a secondary care and outpatient unit of Forensic Psychiatric Centre the Pompestichting in Nijmegen, The Netherlands. The FPOs included in the present study were admitted to Kairos because of aggression regulation problems. Admission to Kairos occurs on either obligatory (e.g. when sentenced by a judge, N = 32) or voluntary basis (based on reference by general practitioner N = 91).

The FPOs were screened by trained clinicians with the Structured Clinical Interview for DSM-IV axis II personality disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000) and the Research Criteria set for Intermittent Explosive Disorder (IED-IR; Coccaro, Kavoussi, Berman, & Lish, 1998). Inclusion to the study required FPOs to comply with the following criteria: 1) a diagnosis of an antisocial, borderline and/or narcissistic personality disorder, and/or intermittent explosive disorder (IED), and 2) have a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). The SDAS measures the severity of current aggressive behavior based on a 5-point rating scale, and can be completed by an observer or by the patient. In this study, due to lack of observers, the SDAS was used as a self-report instrument. Aggressive behavior was rated by each FPO over a period of three months. In addition, FPOs were excluded if there was a current major depression, current severe addiction or lifetime bipolar disorder or any psychotic disorder according to the MINI International Neuropsychiatric Interview (Sheehan et al., 1998; Van Vliet & De Beurs, 2007). None of the FPOs met the exclusion
criteria. The total duration of the assessment was approximately 45 minutes and the study was approved by the Medical Research Ethics Committee (CMO region Arnhem-Nijmegen, The Netherlands). All participants signed a consent form after receiving information about the study and obtained a monetary compensation.

Table 1. Demographic information. Sample size and means, with standard deviations (SD) between brackets

<table>
<thead>
<tr>
<th></th>
<th>Mean / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample size</td>
<td>N = 120</td>
</tr>
<tr>
<td>Age</td>
<td>M = 36.59 (SD = 10.89)</td>
</tr>
<tr>
<td>IQ</td>
<td>M = 88.94 (SD = 12.29)</td>
</tr>
<tr>
<td>Antisocial personality disorder</td>
<td>N = 45</td>
</tr>
<tr>
<td>Borderline personality disorder</td>
<td>N = 23</td>
</tr>
<tr>
<td>Narcissistic personality disorder</td>
<td>N = 4</td>
</tr>
<tr>
<td>Intermittent explosive disorder</td>
<td>N = 100</td>
</tr>
</tbody>
</table>

*measured with the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991)

Materials

The Adult Parental Acceptance and Rejection/control Questionnaire: Short-form (PARQ; Rohner, 2005) assesses an individual’s perceptions of parental acceptance and rejection. It consists of two sets of 29 items, one set for the father and one for the mother, divided into five subscales: Warmth/affection, hostility/aggression, indifference/neglect, undifferentiated rejection, and control. The items are rated on a 4-point Likert scale. The score of the first four subscales were summed to obtain a total score of perceived parental acceptance/rejection. Higher scores on this variable represent high perceived parental rejection. A score of 56 or higher is considered to indicate severe levels of perceived rejection. The PARQ has proven to be reliable and valid; Cronbach’s alpha ranged from .66 to .92 (Nas, Brugman, & Koops, 2008). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha ranged from .77 to .85).

The How I think questionnaire (HIT; Barriga & Gibbs, 1996) is a 54-item self-report questionnaire to assess self-serving cognitive distortions. The items are divided into four cognitive distortion subscales; self-centered, blaming others, minimizing/labeling, assuming the worst, and four behavioral referent categories; physical aggression, opposition-defiance, lying, stealing. Items have to be answered on a 6-point Likert scale. The Dutch translation was found to be reliable and valid; Cronbach’s alpha ranged from .50 to 84 (Morren & Meesters, 2002). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha ranged from .67 to .85).

Statistical analyses

A three-step procedure was applied. First, an initial non-parametric correlation analysis was performed on all subscales of the AQ, PARQ and HIT, to explore the association between these questionnaires (see Table 2 for descriptive statistics for the PARQ, AQ and HIT). A bootstrapping (1000 samples) procedure was used to determine 95% confidence intervals and to test the significance of the correlations. By using bootstrapping, one is able to simulate the population distribution of the correlation and to provide confidence intervals for the correlation coefficients (Sideridis & Simos, 2010). Moreover, when using this approach a more accurate estimate of the associations is provided as compared to estimates produced by a single sample, as would be the case in traditional parametric correlation analysis (Hesterberg, Monaghan, Moore, Clipson, & Epstein, 2003).

In step 2, the Least absolute shrinkage and selection operator (Lasso, available in SPSS as an option of Categorical linear regression (CATREG), SPSS version 20) was used as a data-driven variable selection method, to reduce the amount of subscales of the HIT by identifying the parameters with the most stable contribution in the explained variance of the AQ total score, as all subscales of the HIT were highly correlated with the AQ and because of the high inter-correlation between the subscales of the AQ (van der Kooij, 2007). The Lasso approach successively shrinks the model coefficients to zero by adding a penalty term to the sum of the absolute values of the coefficients in each iteration. Applying this penalty term provides a solution when there is high inter-correlation between predictors (Tibshirani, 1996). For the regularization, the minimum penalty was set at 0.0 and the maximum at 1.0 with a 0.02 increment in shrinkage in each iteration. This procedure yields a model that is biased towards obtaining higher accuracy with the least amount of variables possible and with the smallest predicted margin of error. The expected prediction error was estimated by using the .632 bootstrap procedure (50
samples) (Efron & Tibshirani, 1997). The use of Lasso as a variable selection technique for the identification of variables with high explanatory power was the main purpose of this step. Therefore, the statistical significance of the coefficients was of no interest (see also Brazil et al., 2013). All variables were defined on a numeric scale and discretized by transforming the variables into z-scores and then multiplying them by ten (van der Kooij, Meulman, & Heiser, 2006).

Finally, to investigate distinct patterns of cognitive distortions and the role of perceived parental rejection on aggressive behavior as well as cognitive distortions, Bayesian path analyses were conducted using Mplus version 7 (Muthén & Muthén, 1998). Based on the results of the variable selection step, the HIT scales MM, OD, PA and S were entered as predictors in addition to Parental rejection, while AQ total score served as dependent variable. Furthermore, to explore the indirect effects, parental rejection was also entered as predictor of HIT minimizing/labeling, opposition-defiance, physical aggression, and stealing. This analysis was conducted twice; once for fatherly parental rejection and once for motherly parental rejection. All variables were treated as continuous, observed, variables. Path analyses was conducted with a Bayesian estimator (using the default Gibbs sampler PXa), 4 Markov Chain Monte Carlo (MCMC) chains and 100.000 iterations (of which the first 50.000 were used as burn-in trials) (see also de Vries, Brazil, Tonkin, and Bulten (2016). A Bayesian estimator was favored because it is data driven and, furthermore, it avoids statistical assumptions about the distribution of the test statistics. When the number of observations is relatively small, a Bayesian approach is expected to perform better than traditional Maximum Likelihood estimators because these estimators based on the large-sample theory do not provide good approximations (Muthén, 2010), while Bayesian estimators provide reliable results even in relatively small samples (Scheines, Hoijtink, & Boomsma, 1999).

In this study, a model was considered to show good fit if convergence was achieved with a Proportional Scale Reduction (PSR) ≤ 1.05 (B. Muthén, 2010). Furthermore, the posterior predictive p-value (PPP), a measure of similarity between observed and simulated data generated by the model being examined, should ideally be close to 0.5, which means that the model’s predictions are consistent with the observed data (Gelman, 2013). Finally, the Chi-Square test to conduct Posterior Predictive Checking (with a 95% credibility interval; 95% CI) should include the value 0 (B. Muthén, 2010). Significance of the regression weights were determined based on the 95% CIs of the Bayesian posterior distribution. The 95% CIs of the regression weights that did not contain the value 0 were considered significant.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Rejection</td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>M = 51.61 (SD = 19.37)*</td>
</tr>
<tr>
<td>Mother</td>
<td>M = 41.86 (SD = 14.96)*</td>
</tr>
<tr>
<td>Aggression Questionnaire (AQ)</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td>M = 28.97 (SD = 7.81)</td>
</tr>
<tr>
<td>Verbal</td>
<td>M = 16.70 (SD = 3.66)</td>
</tr>
<tr>
<td>Anger</td>
<td>M = 23.54 (SD = 5.09)</td>
</tr>
<tr>
<td>Hostile</td>
<td>M = 22.85 (SD = 6.01)</td>
</tr>
<tr>
<td>Total</td>
<td>M = 93.05 (SD = 18.18)</td>
</tr>
<tr>
<td>How I Think Questionnaire (HIT)</td>
<td></td>
</tr>
<tr>
<td>Self-centered</td>
<td>M = 2.51 (SD = 9.8)</td>
</tr>
<tr>
<td>Blaming others</td>
<td>M = 2.34 (SD = 7.5)</td>
</tr>
<tr>
<td>Minimizing/labeling</td>
<td>M = 2.39 (SD = 8.4)</td>
</tr>
<tr>
<td>Assuming the worst</td>
<td>M = 2.66 (SD = 7.9)</td>
</tr>
<tr>
<td>Opposition-defiance</td>
<td>M = 2.69 (SD = 8.5)</td>
</tr>
<tr>
<td>Physical aggression</td>
<td>M = 2.68 (SD = 1.62)</td>
</tr>
<tr>
<td>Lying</td>
<td>M = 2.62 (SD = 8.0)</td>
</tr>
<tr>
<td>Stealing</td>
<td>M = 2.01 (SD = 7.6)</td>
</tr>
<tr>
<td>Total</td>
<td>M = 2.49 (SD = 7.5)</td>
</tr>
</tbody>
</table>

*p* significant difference between parental rejection of father as compared to mother, *t*(122) = 7.130, *p* < .001.

### Results

#### Step 1: Correlation analyses

The association between the AQ and PARQ (father and mother) was explored using correlation analyses. All traits of the disposition to act aggressively was significantly correlated with parental rejection by father as well as by mother. Also parental rejection by father and by mother were significantly correlated (*r* < .64, *p* < .001). Furthermore, a high inter-correlation between the subscales of the HIT was found with *r* ranging from .56 to .85 (all *p*’s < .001). Subsequently, to explore the associations between the AQ and the HIT, another correlation analysis was performed in which all subscales of the HIT were correlated with all subscales of the AQ. All subscales of the AQ were significantly correlated with all types of cognitive distortions. The results are displayed in Table 3. A final correlation analysis revealed a high inter-correlation between the subscales and the total score of the AQ, see Table 3. Therefore, in subsequent analyses only the total AQ score was used.
Table 3. Bootstrapped Pearson correlations between cognitive distortions (HIT), parental rejection (PARQ), and aggression traits (AQ). Correlations, 95% confidence intervals (CI) and p-values are reported.

<table>
<thead>
<tr>
<th>AQ</th>
<th>Physical</th>
<th>AQ</th>
<th>Verbal</th>
<th>AQ</th>
<th>Anger</th>
<th>AQ</th>
<th>Hostile</th>
<th>AQ</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIT Self-centered</td>
<td>r = .592, CI = .461 - .694, p &lt; .001</td>
<td>r = .344, CI = .180 - .481, p &lt; .001</td>
<td>r = .477, CI = .312 - .604, p &lt; .001</td>
<td>r = .419, CI = .240 - .564, p &lt; .001</td>
<td>r = .590, CI = .457 - .707, p &lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIT Blaming others</td>
<td>r = .599, CI = .405 - .632, p &lt; .001</td>
<td>r = .329, CI = .182 - .471, p &lt; .001</td>
<td>r = .444, CI = .286 - .566, p &lt; .001</td>
<td>r = .597, CI = .367 - .629, p &lt; .001</td>
<td>r = .587, CI = .356 - .628, p &lt; .001</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>HIT Minimizing/Devaluing</td>
<td>r = .589, CI = .445 - .658, p &lt; .001</td>
<td>r = .335, CI = .162 - .484, p &lt; .001</td>
<td>r = .348, CI = .179 - .503, p &lt; .001</td>
<td>r = .590, CI = .356 - .628, p &lt; .001</td>
<td>r = .587, CI = .356 - .628, p &lt; .001</td>
<td></td>
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</tr>
<tr>
<td>HIT Assuming the worst</td>
<td>r = .559, CI = .405 - .632, p &lt; .001</td>
<td>r = .400, CI = .259 - .516, p &lt; .001</td>
<td>r = .411, CI = .218 - .577, p &lt; .001</td>
<td>r = .515, CI = .355 - .658, p &lt; .001</td>
<td>r = .544, CI = .393 - .665, p &lt; .001</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>HIT Opposition-defiance</td>
<td>r = .565, CI = .405 - .632, p &lt; .001</td>
<td>r = .471, CI = .345 - .591, p &lt; .001</td>
<td>r = .508, CI = .352 - .629, p &lt; .001</td>
<td>r = .554, CI = .393 - .665, p &lt; .001</td>
<td>r = .701, CI = .591 - .782, p &lt; .001</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HIT Physical aggression</td>
<td>r = .667, CI = .560 - .747, p &lt; .001</td>
<td>r = .338, CI = .171 - .485, p &lt; .001</td>
<td>r = .516, CI = .362 - .651, p &lt; .001</td>
<td>r = .469, CI = .300 - .604, p &lt; .001</td>
<td>r = .655, CI = .541 - .744, p &lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIT Lying</td>
<td>r = .387, CI = .211 - .561, p &lt; .001</td>
<td>r = .224, CI = .062 - .380, p &lt; .001</td>
<td>r = .258, CI = .072 - .420, p &lt; .001</td>
<td>r = .286, CI = .090 - .485, p &lt; .001</td>
<td>r = .367, CI = .180 - .544, p &lt; .001</td>
<td></td>
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</tr>
<tr>
<td>HIT Stealing</td>
<td>r = .403, CI = .245 - .556, p &lt; .001</td>
<td>r = .210, CI = .078 - .348, p &lt; .001</td>
<td>r = .310, CI = .128 - .456, p &lt; .001</td>
<td>r = .391, CI = .229 - .518, p &lt; .001</td>
<td>r = .432, CI = .268 - .567, p &lt; .001</td>
<td></td>
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</tr>
<tr>
<td>HIT Total</td>
<td>r = .628, CI = .501 - .727, p &lt; .001</td>
<td>r = .364, CI = .226 - .491, p &lt; .001</td>
<td>r = .463, CI = .281 - .641, p &lt; .001</td>
<td>r = .494, CI = .334 - .639, p &lt; .001</td>
<td>r = .638, CI = .512 - .732, p &lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARQ, Father</td>
<td>r = .509, CI = .329 - .644, p &lt; .001</td>
<td>r = .212, CI = .050 - .370, p &lt; .001</td>
<td>r = .267, CI = .099 - .454, p &lt; .001</td>
<td>r = .320, CI = .167 - .472, p &lt; .001</td>
<td>r = .351, CI = .201 - .491, p &lt; .001</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>PARQ, Mother</td>
<td>r = .207, CI = .044 - .370, p = .021</td>
<td>r = .213, CI = .079 - .346, p &lt; .001</td>
<td>r = .255, CI = .109 - .414, p &lt; .001</td>
<td>r = .312, CI = .168 - .448, p &lt; .001</td>
<td>r = .506, CI = .194 - .338, p &lt; .001</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>AQ Physical</td>
<td>r = .446, CI = .249 - .690, p &lt; .001</td>
<td>-</td>
<td>r = .586, CI = .412 - .757, p &lt; .001</td>
<td>r = .467, CI = .300 - .607, p &lt; .001</td>
<td>r = .840, CI = .767 - .893, p &lt; .001</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ Verbal</td>
<td>-</td>
<td>-</td>
<td>r = .576, CI = .400 - .709, p &lt; .001</td>
<td>r = .495, CI = .349 - .620, p &lt; .001</td>
<td>r = .719, CI = .597 - .808, p &lt; .001</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ Anger</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r = .552, CI = .393 - .674, p &lt; .001</td>
<td>r = .832, CI = .765 - .879, p &lt; .001</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ Hostile</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>r = .786, CI = .710 - .847, p &lt; .001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
optimal model: minimizing/labeling, opposition-defiance, physical aggression, and stealing. Therefore, only these subscales were included in subsequent path analyses.

**Step 3: Path analyses**
Parental rejection, AQ total score, HIT minimizing/labeling, opposition-defiance, physical aggression, and stealing were included in the model. It was investigated whether distinctive patterns of cognitive distortions were related to aggressive behavior and whether parental rejection had a direct effect on AQ total score and/or an indirect effect via HIT minimizing/labeling, opposition-defiance, physical aggression, and stealing. This analysis was conducted twice: once with parental rejection by the father and once for parental rejection by the mother. The model as a result of the Bayesian path analysis for parental rejection by the father is displayed in Figure 2 (only significant results are displayed) and is similar to the model for parental rejection by the mother. The results revealed that parental rejection, by both mother and father, had a direct effect on AQ total score and an indirect effect on AQ via opposition-defiance, see Table 4. No indirect effect via minimizing/labeling, physical aggression, and stealing emerged in either model. Additionally, only opposition-defiance and physical aggression had direct effect on AQ total score. For the model including parental rejection of father, the 95% credibility interval for the difference between the observed and the replicated Chi-Square values is -19.01 to 22.33. Posterior predictive p-value = .44. For the model regarding parental rejection of mother the 95% credibility interval for the difference between the observed and the replicated Chi-Square values is -19.16 to 22.40. Posterior predictive p-value = .44. Thus, both models showed a similar and excellent model fit.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Parameter</th>
<th>Estimate (β)</th>
<th>95% C.I. Lower 2.5%</th>
<th>Upper 2.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental rejection Father AQ Baseline</td>
<td>Parental rejection</td>
<td>0.205</td>
<td>0.086</td>
<td>-0.319*</td>
</tr>
<tr>
<td></td>
<td>HIT minimizing/labeling</td>
<td>-0.185</td>
<td>-0.427</td>
<td>-0.056</td>
</tr>
<tr>
<td></td>
<td>HIT opposition-defiance</td>
<td>-0.405</td>
<td>-0.349</td>
<td>-0.469*</td>
</tr>
<tr>
<td></td>
<td>HIT physical aggression</td>
<td>0.389</td>
<td>0.176</td>
<td>0.593*</td>
</tr>
<tr>
<td></td>
<td>HIT stealing</td>
<td>-0.152</td>
<td>-0.355</td>
<td>-0.051</td>
</tr>
<tr>
<td></td>
<td>HIT minimizing/labeling</td>
<td>0.095</td>
<td>-0.082</td>
<td>0.263</td>
</tr>
<tr>
<td></td>
<td>HIT opposition-defiance</td>
<td>-0.220</td>
<td>-0.046</td>
<td>-0.370*</td>
</tr>
<tr>
<td></td>
<td>HIT physical aggression</td>
<td>0.079</td>
<td>-0.097</td>
<td>0.248</td>
</tr>
<tr>
<td></td>
<td>HIT stealing</td>
<td>-0.098</td>
<td>-0.079</td>
<td>0.266</td>
</tr>
<tr>
<td></td>
<td>Indirect effect Parental rejection, HIT Opposition-defiance, AQ</td>
<td>0.125</td>
<td>0.025</td>
<td>-0.262*</td>
</tr>
<tr>
<td>Parental rejection Mother AQ Baseline</td>
<td>Parental rejection</td>
<td>-0.176</td>
<td>0.057</td>
<td>-0.291*</td>
</tr>
<tr>
<td></td>
<td>HIT minimizing/labeling</td>
<td>-0.174</td>
<td>-0.418</td>
<td>-0.072</td>
</tr>
<tr>
<td></td>
<td>HIT opposition-defiance</td>
<td>0.634</td>
<td>0.378</td>
<td>-0.078*</td>
</tr>
<tr>
<td></td>
<td>HIT physical aggression</td>
<td>0.370</td>
<td>0.155</td>
<td>-0.276*</td>
</tr>
<tr>
<td></td>
<td>HIT stealing</td>
<td>-0.165</td>
<td>-0.370</td>
<td>-0.040</td>
</tr>
<tr>
<td></td>
<td>HIT minimizing/labeling</td>
<td>0.052</td>
<td>-0.124</td>
<td>0.223</td>
</tr>
<tr>
<td></td>
<td>HIT opposition-defiance</td>
<td>0.182</td>
<td>-0.007</td>
<td>-0.342*</td>
</tr>
<tr>
<td></td>
<td>HIT physical aggression</td>
<td>-0.064</td>
<td>-0.112</td>
<td>-0.234</td>
</tr>
<tr>
<td></td>
<td>HIT stealing</td>
<td>-0.104</td>
<td>-0.095</td>
<td>-0.253</td>
</tr>
<tr>
<td></td>
<td>Indirect effect Parental rejection, HIT Opposition-defiance, AQ</td>
<td>-0.141</td>
<td>0.005</td>
<td>-0.317*</td>
</tr>
</tbody>
</table>
Parental Rejection, Aggression and Distorted Cognition

Perceived parental rejection, measured retrospectively, appeared to be associated with the disposition to act aggressively in male adult FPOs. Furthermore, significant correlations emerged between aggressive behavior and cognitive distortions. The findings of the path analyses, however, indicated that cognitive distortions related to opposition-defiance (OD) and physical aggression (PA) were most strongly associated with self-reported aggressive behavior (see Figure 2). The current results are in partial agreement with previous findings indicating that distinct types of cognitive distortions were differentially related to verbal and physical aggressive behavior (Barriga et al., 2008). In the current study, cognitive distortions were associated with the disposition to act aggressively in general. Additionally, our findings provide evidence for a stronger association between cognitive distortions related to OD and PA and aggressive behavior as compared to the other types of distorted cognitions, in a sample of FPOs displaying pathological levels of aggression. This suggests that underlying cognitive distortions have a different impact on severe aggressive behavior, which is of special interest with respect to the treatment of aggressive behavior.

In addition, an association was found between perceived parental rejection and aggressive behavior. The present results are in line with previous literature suggesting that parental rejection and insecure attachment are related to aggressive behavior in childhood, adolescence, and adulthood (Brendgen et al., 2001; Eron et al., 1991; Gallarin & Alonso-Aribol, 2012; Khaleque & Rohner, 2012; Rohner, 2016; Leary et al., 2006; Savage, 2014). Additionally, our study is one of the first to point out that (retrospectively) perceived parental rejection is linked to self-reported aggression. The results may underline the notion that an individual's experiences and views on parental behavior during maturation are associated with current aggressive behavior in adult FPOs. Our findings suggest that it is important to take into account that aggression might have its origin in environmental factors such as parental rejection that have a profound impact on an individual's cognitive processing style.

Furthermore, an indirect link via cognitive distortions was found in addition to the direct link between parental rejection and aggressive behavior (see also de Vries et al., 2015). The current findings complement the study by de Vries et al. (2015) by showing that this link is measurable retrospectively. In addition, the indirect link only emerged regarding cognitive distortions related to OD. The items belonging to this subscale are associated with disrespecting rules, laws, and authority and external reasons for deviant behavior. Parental rejection seems to contribute to the development of these more general deviant cognitions, which in turn may lead to the development of more specific cognitive distortions, for instance related to physical aggression, as all the subscales of the HIT emerged to be highly correlated.

Clinical implications
Successful treatment requires exploration of the parental bonding and the cognitive processing style of the patient. Cognitive therapeutic interventions should be more concentrated on the aforementioned specific cognitions that are distorted instead of more general cognitive therapy. In the end, this will result in more targeted treatments which are further aimed at, and probably also more successful in, reducing aggressive behavior. Moreover, it might be of interest to explore involving family systems in interventions to reduce aggressive behavior. Several studies have shown that this is effective in reducing conduct problems in adolescents (e.g. Farrington &Welsh, 2005; van der Stouwe, Asscher, Stams, Deković, & van der Laan, 2014). As parental rejection was reported retrospectively, it might be of importance to discuss these experiences with ones parents (if possible). One might speculate that by elucidating these experiences, this also may have a positive effect.
on the current relationship between an adult and his parents which, subsequently, might have positive effects on the reduction of aggressive behavior.

Limitations
The present study and results have a number of limitations which merit further comment. First of all, it could be argued that the fact that all measurements consisted of self-report scores could be a limitation of this study, as participants could have answered the question in a socially desirable way (Colet, Parnies, Carrasco, & Seva, 2012). However, a recent meta-analysis on this issue found that social desirability in responding is limited in the measurement of self-reported psychopathy, a condition typified by excessive use of aggression and elevated prevalence of childhood maltreatment (Ray et al., 2013). This suggests that the use to self-report in aggressive populations, such as the one used in the current study, can be considered to be a valid approach. Another consideration is that forensic psychiatric patients may not be fully capable of reflecting on their own behavior and that the cognitive distortions displayed by FPOs affect the way they filled out questionnaires (Schmidt, Banse, & Imhoff, 2015). One way of remedying this issue would be to try to replicate the current findings using more implicit measures in order to rule out this possibility. Lastly, the questionnaire regarding parental rejection was filled out retrospectively and the information was not verified with parents. As retrospective measures of childhood experiences are assumed to be sensitive to distortions, it might be possible that there was a memory bias or that the patients’ current views on their prior caregivers are affected by recent events or current mood (Brewin, Andrews, & Gotlib, 1993). Note, however, that a review suggested that retrospective measures still tend to be reliable (Brewin et al., 1993).

Conclusions
The present results revealed that perceived parental rejection contributes directly to the development of aggressive behavior in adult FPOs with severe aggression problems and also indirectly via the emergence of cognitive distortions. The findings seem to stress the notion that the consequences of parental rejection during childhood are profound and result in impairments which remain present during adulthood. Regarding prospective research, it would be of great interest to investigate the development of cognitive distortions and to explore whether cognitive distortions are associated with aggression change over time in, e.g., a longitudinal design. The cognitive distortions related to OD and PA, found to be strongly associated with aggressive behavior, need to be elucidated in further detail in order to take further steps towards personalized treatment. This form of intervention may enhance treatment adherence and improve the effectiveness. In the long run, this might result in a more successful reduction of aggressive behavior.

References
Parental Rejection, Aggression and Distorted Cognition


Chapter 4

Associations of Multiple Trauma Types and MAOA with Severe Aggressive Behavior and MAOA effects on Training Outcome

Smeijers, D., Bulten, E., Franke, F., Buitelaar, J., & Verkes, R.J. Associations of Multiple Trauma Types and MAOA with Severe Aggressive Behavior and MAOA effects on Training Outcome. (Revision submitted).
Introduction

It is well known that early life maltreatment significantly increases risk for the development of aggressive behavior in adulthood (e.g. Gilbert et al., 2009; Huizinga et al., 2006; Kolla & Nigel Blackwood, 2015; Rehan, Sandnabba, Johansson, Westberg, & Santtila, 2015). Physical, sexual, and emotional abuse and neglect are forms of maltreatment, which are widely recognized and unfortunately occur frequently (Gilbert et al., 2009). These traumas also often occur together or sequentially (Huizinga et al., 2006). Experiencing multiple trauma types has been associated with more chronic health and psychological problems than experiencing a single, isolated trauma (Agorastos et al., 2014; Finkelhor, Ormrod, & Turner, 2007a, 2007b; Ford, Elhai, Connor, & Frueh, 2010; Grasso, Greene, & Ford, 2013; Martin, Cromer, DePrince, & Freyd, 2013). Focusing on a single type of trauma may lead to overestimates of the impact of a specific stressor and may miss out on cumulative effects of experiencing multiple types of trauma (Grasso et al., 2013).

Genetic variation of the serotonergic and dopaminergic neurotransmitter systems also appear to be important modulators of antisocial and aggressive behavior (Veroude et al., 2016). One of the genes thoroughly studied in this regard is the X-chromosomal monoamine oxidase A gene (MAOA), which encodes the enzyme monoamine oxidase A, responsible for the catabolism of dopamine, serotonin, as well as norepinephrine (Bortolato, Chen, & Shih, 2008; Veroude et al., 2016). The MAOA gene contains a variable number of tandem repeat (VNTR) variant, which influences gene-expression: alleles with 2 and 3 repeats of this VNTR show lower gene-expression (MAOA-L) than those with 3.5 and 4 repeats (MAOA-H) (Kim-Cohen et al., 2006). Given its X-chromosomal location, males carry only one copy of the gene, whereas females have two. A gene-environment interaction (GxE) between the low activity variant and adverse childhood events on increased risk of aggressive and antisocial behavior was first observed in a general population study (Caspi et al., 2002) and has subsequently been reported in many additional samples, including children, adolescents, adults, healthy individuals, and psychiatric patients (for review see e.g. Buades-Rotger & Gallardo-Pujol, 2014; Shina, 2015; Sohrabi, 2015; Veroude et al., 2016). A recent meta-analysis confirmed the GxE between the MAOA-L genotype and early life adversities in males, whereas in females this GxE could not be replicated (Byrd & Manuck, 2014).

The populations investigated in the studies mentioned above mainly include healthy individuals not typified by severe levels of aggression. To date, only two studies have investigated the association between MAOA-L and aggression in groups with serious aggressive behavior. In a sample of alcoholic violent offenders (N=174) an interaction between the MAOA-H genotype and childhood physical abuse before 13 years was found.
associated with an increased risk for severe, impulsive, violent recidivist crimes (Tikkanen et al., 2010). In a study of 692 prisoners, carriers of the MAOA-H genotype not exposed to physical neglect showed higher levels of aggression (Gorodetsky et al., 2014). These results contradict the findings in the general population, and no explanation for this contradiction is available. Prisoner samples are characterized by, for instance, high levels of anger and aggression, they, therefore, might be an atypical group (Gorodetsky et al., 2014). However, the samples investigated in both studies were relative heterogeneous, consisting of violent offenders and individuals convicted for crimes like robbery, terrorist activity, fraud, or drug use or sale. Therefore, additional research is needed on the interaction between adverse childhood events and genetic disposition as risk factors for severe aggressive behavior. Another largely unexplored issue is, how the aforementioned multiple types of traumas and their interaction with a genetic predisposition might be relevant to our understanding of GxE for the development of disproportionate and/or persistent aggressive behavior might help in developing targeted interventions and prevention (Bakermans-Kranenburg & van Ijzendoorn, 2011; Shiina, 2015).

In addition to the classic stress-vulnerability model of GxE, the differential susceptibility hypothesis may be relevant to our understanding of GxE for MAOA and adversity in aggression. This latter hypothesis postulates that those individuals who are most susceptible to adversity, because of their make-up (e.g. behavioral or genetically), are simultaneously most likely to benefit from supportive or enriching experiences (Belsky, 1997; Belsky, 2005; Belsky & Pluess, 2009). Support for the differential susceptibility perspective on aggression was provided by a general population study (Simons et al., 2011). This study revealed that individuals carrying risk alleles in the 5HTT and DRD4 genes demonstrated more aggressive behavior than non-carriers, when the environment was adverse, whereas when social conditions were favorable, less aggression was displayed. Regarding individuals receiving treatment for aggression regulation problems, it could thus be hypothesized that those who are genetically more responsive to negative environmental factors might also benefit more from positive events and environments, like psychotherapeutic interventions. This idea is supported by recent meta-analyses, which revealed larger intervention effects among genetically susceptible groups (Bakermans-Kranenburg & van Ijzendoorn, 2011, 2015; van Ijzendoorn & Bakermans-Kranenburg, 2015). For instance, children with a 7-repeat allele of a VNTR in the DRD4 gene, associated with externalizing problem behavior in those with an unresponsive mother (Bakermans-Kranenburg & van Ijzendoorn, 2011; Bakermans-Kranenburg, Van IJzendoorn, Pijlman, Mesman, & Juffer, 2008).

In the present study, the potential interactive effect of MAOA genotype and having experienced multiple trauma types in explaining aggressive behavior in a population of forensic psychiatric outpatients (FPOs) diagnosed with and receiving treatment for aggression regulation problems was explored. All FPOs received the Aggression Replacement Training (ART). In addition, it was investigated, whether male FPOs with the MAOA-L risk allele had a better treatment response, in line with the differential susceptibility hypothesis.

**Experimental procedures**

**Participants**

One hundred fifty forensic psychiatric outpatients (FPOs) with aggression regulation problems participated in the study (see Table 1 for demographic information). The FPOs were recruited from a series of patients admitted to “Kairos”, secondary care and outpatient unit of Forensic Psychiatric Center the Pompestichting in Nijmegen, The Netherlands. The FPOs included in the present study were admitted to Kairos because of aggression regulation problems. Admission to Kairos occurs on either obligatory (when sentenced by a judge) or voluntary basis (based on reference by a general practitioner). Forty-one patients were obligatory and 109 referred voluntarily. All FPOs received an intervention called Aggression Replacement Training (ART; Glick & Goldstein, 1987; Goldstein, Glick, & Gibbs, 1998).

Table 1. Demographic information of severely aggressive forensic psychiatric outpatients (FPOs)

<table>
<thead>
<tr>
<th></th>
<th>Mean / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>M = 35.81 (SD = 10.67)</td>
</tr>
<tr>
<td>IQ*</td>
<td>M = 87.91 (SD = 11.74)</td>
</tr>
<tr>
<td>Male</td>
<td>N = 142</td>
</tr>
<tr>
<td>Female**</td>
<td>N = 8</td>
</tr>
<tr>
<td>Baseline measurement</td>
<td>N = 150</td>
</tr>
<tr>
<td>Half-way measurement</td>
<td>N = 111</td>
</tr>
<tr>
<td>End of treatment measure</td>
<td>N = 105</td>
</tr>
<tr>
<td>Antisocial personality disorder</td>
<td>N = 58</td>
</tr>
<tr>
<td>Borderline personality disorder</td>
<td>N = 31</td>
</tr>
<tr>
<td>Narcissistic personality disorder</td>
<td>N = 4</td>
</tr>
<tr>
<td>Intermittent explosive disorder</td>
<td>N = 133</td>
</tr>
</tbody>
</table>

* as measured by using the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991)
** as excluded from genotype analysis
Before inclusion in the study, FPOs were screened for exclusion criteria: current major depression, current severe addiction, or lifetime bipolar disorder or psychosis, as assessed using the MINI International Neuropsychiatric Interview (Sheehan et al., 1998; Van Vliet & De Beurs, 2007). The FPOs included in the study were screened by trained clinicians to verify an axis II disorder with the Structured Clinical Interview for DSM-IV axis II personality disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000) and the Research Criteria set for Intermittent Explosive Disorder (Coccaro, Kavoussi, Berman, & Lish, 1998). Inclusion in the study required FPOs to comply with one or more of the following criteria: 1) an antisocial, borderline, and/or narcissistic personality disorder, and/or the intermittent explosive disorder (IED), and 2) a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). The study was approved by the regional research ethics committee (CMO region Arnhem-Nijmegen, The Netherlands). All participants signed a consent form after receiving information about the study and obtained a monetary compensation.

**Instruments**

*The Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990)* is an observer-scale that measures the severity of actual aggressive behavior. It consists of nine items measuring outward aggression and two items measuring inward aggression. Items are scored on a 4-point Likert scale with 0 = not present and 4 = severely to extremely present as extremes. The SDAS has adequate observer reliability (Cronbach’s Alpha=.79; Wistedt et al., 1990). In the current study, due to lack of observers, the SDAS was used as self-report and was the main treatment outcome measure. Participants had to rate their aggressive behavior over a period of three months (baseline), half-way their intervention, and at the end of treatment measurement. We have earlier described their aggressive behavior over a period of three months (baseline), half-way their intervention, and at the end of treatment measurement. We have earlier described their aggressive behavior during this intervention (N=58). Both, the regular ART and the ART for domestic violence perpetrators, as offered by “Kairos”, consisted of two of the three original modules: 1) social skills training and 2) anger control training. Both interventions occurred either in groups (N=116) or individually (N=46) and consisted of twelve 90-minutes weekly sessions. Indication for ART was determined by a multidisciplinary team. The ART therapists were all trained in applying the ART and, in addition, made use of a detailed intervention manual and participated in intervention.

**Genotyping**

Genetic analyses were carried out at the Department of Human Genetics of the Radboud University Medical Center in Nijmegen. Saliva samples were collected using Oragene kits (DNA Genotek, Kanata, Canada), and genomic DNA was extracted according to the protocol specified by the manufacturer. Subsequently, polymerase chain reaction (PCR) was used to amplify the X-chromosomal genomic region containing the *MAOA* variant. For the PCR, 30 ng genomic DNA was combined with 2.5 pM forward primer (5’ –ACAGCCTGACCGTGGAAGAC – 3’, fluorescently labeled with 6-carboxyfluorescin, Applied Biosystems, Nieuwerkerk aan de IJssel, The Netherlands), 2.5 pM reverse primer (5’ –GAACGGACGCCCTTCATTGGGA – 3’, Applied Biosystems) and 1x AmpliTaq Gold 360 master mix (Applied Biosystems). The PCR protocol consisted of one cycle of 95°C for 10 minutes, followed by 35 cycles of 95°C for 30 seconds, 60 °C for 30 seconds, and 72°C for 1 minute, ending with a final cycle of 72°C for 7 minutes. The product of the amplification was diluted 1:30 in H2O. Determination of the length of the allele was performed by direct analysis on an automated capillary sequencer (ABI 3730, Applied Biosystems) using standard conditions. The resulting data was processed with Genemapper version 4.0 (Applied Biosystems). Generally, 3% blanks as well as duplicates within and between plates were taken along as quality controls during genotyping.

**Statistical analysis**

It was first examined whether FPOs receiving ART as usual and ART for domestic violence perpetrators and those receiving group or individual ART could be considered as one sample in subsequent analyses. A MANOVA was conducted to investigate differences of the trauma. The SCTI has a good test-retest reliability (Kremers, Spinrhoven, & Does, 2004).

**Intervention: Aggression Replacement Training (ART)**

All FPOs were referred to the ART. Besides ART for general aggression and violence, ART was also offered for perpetrators of intimate partner violence. This version of the ART is identical to the regular ART, except that the partners of the FPOs were involved during this intervention (N=58). Both, the regular ART and the ART for domestic violence perpetrators, as offered by “Kairos”, consisted of two of the three original modules: 1) social skills training and 2) anger control training. Both interventions occurred either in groups (N=116) or individually (N=46) and consisted of twelve 90-minutes weekly sessions. Indication for ART was determined by a multidisciplinary team. The ART therapists were all trained in applying the ART and, in addition, made use of a detailed intervention manual and participated in intervention.
between the SDAS scores between the aforementioned groups. Subsequently, the FPOs were subdivided in three groups regarding early life trauma type (FPOs having experienced no early life trauma, FPOs with a single trauma type, FPOs with multiple trauma types). Early life trauma was categorized as present, if a traumatic event was reported and it was experienced as stressful. The groups were further stratified according to the presence of the MAOA-L allele. In this latter analysis, we excluded the eight females, due to unknown effects of X-inactivation (Benjamin, Van Bakel, & Craig, 2000; Carrel & Willard, 2005; Kim-Cohen et al., 2006). Subsequently, effects of traumatic events (N = 150) and MAOA genotype (N = 142) on aggressive behavior (SDAS baseline measurement) were examined using ANOVA. In a second ANOVA, the interaction between MAOA genotype and traumatic experiences was added into the model in addition to the main effects of MAOA genotype and trauma (N = 142). In all analyses, Bonferroni correction was used to control for multiple comparisons.

To examine, whether a genetic disposition was associated with treatment susceptibility, a linear mixed model (SPSS, version 20) was used. One advantage of this analysis is that it is possible to include individuals with incomplete data, without imputing data (Heck, Thomas, & Tabata, 2013). As the aggression assessment half-way and at the end of treatment were not completed for all participants, this method was favored. The model was a repeated-measures design with aggressive behavior measured with the SDAS as dependent variable, Time of measurement (baseline, half-way, end of treatment) as within-subjects factor, and Group (MAOA-L presence and absence) as between-subjects factor. Repeated covariance type was set at diagonal. For the Time variable, the slope was set as a fixed effect and the intercept as a random effect. This random effect was defined in order to assess variation in the dependent variable, because variation among individuals in aggression at baseline was assumed (Bolker et al., 2009; West, Welch, & Galecki, 2014). Group was included as fixed factor and a fixed Group × Time factor was included. The covariance type for the random effects was set at unstructured. As linear mixed models do not provide effect sizes, Cohen’s D was calculated by dividing the mean difference between pre- and post-SDAS scores by the pooled standard deviation.

**Results**

**Differences among FPOs**

No significant multivariate effects of ART versus ART for domestic violence and group versus individual treatment emerged, Wilks’ Lambda=.988, F(3, 89)=.373, p=.775, etap²=.012; Wilks’ Lambda=.996, F(3, 89)=.112, p=.953, etap²=.004, respectively. Therefore, in subsequent analyses the FPOs were considered as one sample.

**Main effects of trauma and genotype and gene-environment interaction**

Means on the SDAS baseline measurement are displayed in Table 2. Significant main effects of trauma as well as genotype were found, F(2, 147)= 8.691, p<.001, etap²=.106; F(1, 140)=4.264, p=.041, etap²=.030, respectively. Group-wise comparisons regarding trauma revealed that FPOs with multiple types of trauma reported more aggression at baseline measurement than FPOs with single type and no trauma (single type: p=.002; no trauma: p=.010). FPOs with single type of trauma and no trauma did not significantly differ from each other (p=.100). FPOs carrying the MAOA-L allele reported higher levels of aggression at baseline measurement than those without this genotype. When the GxE effect was introduced in the model, the main effect of genotype as well as the genotype × trauma effect were non-significant, F(1, 136)=1.559, p=.214, etap²=.011; F(2, 136)=.579, p=.562, etap²=.008, respectively.

**Differential susceptibility model for treatment response**

In the linear mixed model investigating differential responses to ART, a significant main effect of Time was found, but the effects of Group and Time × Group did not reach significance (see Table 3). A graphic representation of the change in aggressive behavior per genotype is displayed in Figure 1. Aggression was reduced during treatment in both genotype groups to a similar extent over the course of treatment. Cohen’s D for the overall mean difference between baseline and end of treatment SDAS scores was 1.08, representing a large effect size.

Although not a primary objective of this study, it was also analyzed, whether trauma history was associated with treatment outcome in the total sample (N = 150). A linear mixed model indeed identified a significant main effect of Trauma as well as a significant Time × Trauma effect (see Table 3). A graphic representation of the change in aggressive behavior for all three trauma groups is displayed in Figure 2. The trauma groups showed a differential pattern of aggression reduction; FPOs who experienced no traumas showed the strongest reduction of aggressive behavior during treatment, FPOs with a single type of trauma on the other hand showed the slowest reduction of aggression during...
treatment. FPOs with multiple types of trauma reported the highest levels of aggressive behavior over the course of treatment.

Table 2. Means on the Social Dysfunction and Aggression Scale (SDAS) baseline measurement

<table>
<thead>
<tr>
<th>Trauma (N = 150):</th>
<th>SDAS baseline measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPOs without trauma (N = 29):</td>
<td>M = 13.34 (SD = 6.09)</td>
</tr>
<tr>
<td>FPOs with single trauma type (N = 27):</td>
<td>M = 11.96 (SD = 5.15)</td>
</tr>
<tr>
<td>FPOs with multiple trauma types (N = 94):</td>
<td>M = 16.87 (SD = 6.64)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Genotype (N = 150; female/male):</th>
<th>SDAS baseline measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPOs without MAOA-L (N = 52; 1/51):</td>
<td>M = 13.69 (SD = 6.21)</td>
</tr>
<tr>
<td>FPOs with MAOA-L (N = 98; 7/91):</td>
<td>M = 15.86 (SD = 6.72)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gene × Environment (N = 91, without females):</th>
<th>SDAS baseline measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPOs with MAOA-L, without trauma (N= 21):</td>
<td>M = 13.48 (SD = 6.39)</td>
</tr>
<tr>
<td>FPOs with MAOA-L, with single trauma type (N = 16):</td>
<td>M = 12.13 (SD = 4.83)</td>
</tr>
<tr>
<td>FPOs with MAOA-L, with multiple trauma types (N = 54):</td>
<td>M = 17.89 (SD = 6.64)</td>
</tr>
</tbody>
</table>

Note: Superscripts of mean values indicate significant group differences: groups with different superscripts differ from each other at least p<.05.

Table 3. Results of linear mixed model; MAOA and trauma effects on treatment outcome

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>95% CI</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>15.66</td>
<td>14.32 – 17.00</td>
<td>23.10</td>
<td>140.22</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Time</td>
<td>-1.79</td>
<td>-4.54 – -0.04</td>
<td>-10.01</td>
<td>112.94</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Genotype group</td>
<td>-1.54</td>
<td>-4.17 – 0.93</td>
<td>-1.83</td>
<td>120.41</td>
<td>.089</td>
</tr>
<tr>
<td>Time × Genotype group</td>
<td>.96</td>
<td>-.25 – 2.18</td>
<td>1.57</td>
<td>110.66</td>
<td>.120</td>
</tr>
<tr>
<td>Intercept</td>
<td>12.03</td>
<td>9.67 – 14.38</td>
<td>10.09</td>
<td>147.88</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Time</td>
<td>-1.91</td>
<td>-3.28 – -0.54</td>
<td>-2.76</td>
<td>119.35</td>
<td>.007</td>
</tr>
<tr>
<td>Trauma group 1</td>
<td>.79</td>
<td>-2.48 – 4.07</td>
<td>48</td>
<td>147.42</td>
<td>.631</td>
</tr>
<tr>
<td>Trauma group 2</td>
<td>4.67</td>
<td>1.99 – 7.34</td>
<td>3.45</td>
<td>147.63</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Time × Trauma group 1</td>
<td>-2.04</td>
<td>-3.89 – -0.19</td>
<td>-2.18</td>
<td>115.99</td>
<td>.031</td>
</tr>
<tr>
<td>Time × Trauma group 2</td>
<td>-1.71</td>
<td>-3.26 – -0.16</td>
<td>-2.19</td>
<td>119.28</td>
<td>.031</td>
</tr>
</tbody>
</table>

Figure 1. Graphical representation of aggression reduction during treatment for FPOs with and without MAOA-L genotype

Figure 2. Graphical representation of aggression reduction during treatment for FPOs with and without MAOA-L genotype

Figure 3. Graphical representation of aggression reduction during treatment for FPOs with and without MAOA-L genotype
Discussion

In the present study, we investigated the potential effect of MAOA genotype and having experienced multiple trauma types as well as their interaction on explaining aggression among FPOs. Furthermore, a differential susceptibility model for MAOA in the response to Aggression Replacement Training (ART) was explored. Although the reported effects sizes were rather small, which is in agreement with other studies (Buades-Rotger & Gallardo-Pujol, 2014; Rehan et al., 2015; Young et al., 2006), we found that those FPOs having experienced multiple types of trauma and the FPOs with the MAOA-L allele displayed the highest levels of aggression. No significant interaction effect between trauma and MAOA-L genotype emerged, and no evidence was found for a differential susceptibility model. It, however, was found that FPOs with a traumatic history showed higher levels of aggression over the course of treatment.

The current findings may indicate that experiencing multiple types of early life traumatic events significantly increases the risk for the development of severe aggressive behavior. No effects were seen in those who had experienced only one type of trauma. The current finding is in agreement with studies showing the association between early life maltreatment and aggression in adulthood (e.g. Gilbert et al., 2009; Haller, Harold, Sandi, & Neumann, 2014; Huizinga et al., 2006; Kolla & Nigel Blackwood, 2013; Rehan et al., 2015). The present results complement previous findings by revealing this link in adults characterized by severe aggressive behavior. It is thought that early victimization has sustained effects; it predicts later victimization and is associated with later aggression (Logan-Greene, Nurius, Hooven, & Thompson, 2013). Early life adverse events result in unfavorable cognitive and emotional patterns, which are thought to hamper the development of appropriate coping and problem-solving skills (Hosser, Raddatz, & Windzio, 2007; Logan-Greene et al., 2015). It is conceivable that these skills, which are thought to increase the likelihood of aggressive behavior, are even more underdeveloped in victims of multiple types of trauma (Hosser et al., 2007; Logan-Greene et al., 2015). This may have important clinical implications; behavioral aggression interventions often appeal to these and associated skills. Patients need to increase impulse regulation and need to learn how to behave in a pro-social manner by using social skills and increase moral reasoning (Glick & Goldstein, 1987; Goldstein et al., 1998). As also a less rapid reduction of aggression was found among FPOs with a history of multiple traumas, it might be of importance to pay special attention to improving general coping and problem-solving skills in order to be able to develop new skills to control aggressive impulses. Furthermore, education and/or interventions should be targeted better towards risk populations to prevent the development of escalated aggressive behavior. This stresses the importance of early recognition of early life adversity and paying special attention to multiple types of traumatic experiences (Rehan et al., 2015) in adults with severe aggression.

Even though the interaction between MAOA-L genotype and adverse early life events is widely accepted (e.g. Buades-Rotger & Gallardo-Pujol, 2014; Byrd & Manuck, 2014; Sohrabi, 2015; Veroude et al., 2016), inconsistencies appear among studies investigating this interaction. Our findings are consistent with previous studies failing in replicating the interaction effect of the MAOA-L risk allele and early life traumatic events (Buades-Rotger & Gallardo-Pujol, 2014; Haberstick et al., 2005; Huizinga et al., 2006; Rehan et al., 2015; Young et al., 2006). However, a main effect of genotype did emerge; FPOs with the MAOA-L risk allele displayed more severe aggressive behavior. Previous research suggested an association between MAOA-L and reactive aggression specifically, which is defined as an impulsive, angry, or defensive response to threat, provocation, or frustration (Crick & Dodge, 1996). This link is replicated in the present study, as the current sample consisted of FPOs who mainly displayed reactive aggressive behavior. It is thought that the MAOA-L gene variant has impact on brain development and is associated with a more labile socio-cognitive processing system, which is characterized by an increased tendency to react in a hostile manner to aggressive and ambiguous cues (Buckholtz & Meyer-Lindenberg, 2008). Reactive aggression is characterized by hostile attribution biases (e.g. Crick & Dodge, 1996; Dodge, 2006). A study by Wakschlag et al. (2010) revealed that healthy female adolescents with MAOA-H genotype showed a greater tendency towards a hostile attribution bias. One may argue that these kind of biases are due to a genetic predisposition, which in turn is associated with an increased risk for aggressive behavior.

No evidence was found for a genetic differential susceptibility model for MAOA in ART. FPOs with the MAOA-L risk allele did not display a more favorable response to treatment than FPOs without this genetic variant. Previous therapy-genetics studies mainly focused on dopamine- and serotonin-related genotypes (Bakermans-Kranenburg & Van Ijzendoorn, 2015), and although there seems to be evidence for differential susceptibility for MAOA (Belsky & Pluess, 2009), to date, this is only the second study to investigate the gene. A previous study by Reif et al. (2014) revealed that MAOA-H was associated with worse responses to cognitive behavioral therapy for panic disorder with agoraphobia compared to MAOA-L. Although the current study did not find support for the differential susceptibility hypothesis, it does not mean that this hypothesis is refuted. It might be that alleles from other genes were involved and interacted with MAOA or trauma (Belsky & Pluess, 2013). Furthermore, several other factors could have moderated the differential susceptibility effect, such as difficult temperament, negative emotionality, and physiological stress reaction (Belsky & Pluess, 2013). It also may be conceivable...
that the association between the MAOA-L variant and susceptibility to treatment is moderated by discouraging personal circumstances. Aggression is associated with numerous discouraging factors such as substance use, social isolation, and absenteeism from work (van der Kraan et al., 2014; WHO, 2007). These factors may contribute to the maintenance of aggression, and it may be suggested that they might undo or affect the positive treatment effects negatively.

The present study and results should be viewed in the context of strengths and limitations. A clear strength of this study is the inclusion of severely aggressive FPOs, which gave us the unique opportunity to investigate underlying mechanisms of aggressive behavior in a subpopulation to which this knowledge is immediately applicable. However, the current sample was relatively small and the distribution of FPOs over the three trauma groups was unequal. Furthermore, due to the small sample size, the current study is relatively underpowered to evaluate the role of the MAOA genotype. The results of the genetic analyses, therefore, should be interpreted with caution. Fourth, the measurement of aggression and trauma consisted both of self-report. It is questionable, whether a population of FPOs is fully able to reflect on their own behavior, and whether they are willing to answer genuinely or whether a recall-bias occurred. As only a small number of women participated, the current findings on multiple trauma types may not be generalizable to a female population with aggression regulation problems. Furthermore, the role of MAOA genotype among women is uncertain due to random X-inactivation (Benjamin et al., 2000; Carrel & Willard, 2005).

As only the MAOA gene was considered in the current study, future research should include additional genes, preferably those identified in hypothesis-free genome-wide studies (e.g. Aebi et al., 2015; Brevik et al., 2016), as aggression is a complex behavior and, therefore, is likely to be explained by a complex interaction between multiple genes (Vassos, Collier, & Fazel, 2014). Additionally, no information was available regarding social economic status, developmental factors, such as the stability of one’s family, current discouraging circumstances, and age at different traumas. As these factors all could be confounders in the gene × environment analyses, including them in future research might improve results.

Notwithstanding the limitations and observational nature of the current study, the results suggest that in a population of severely aggressive adult FPOs, multiple types of early life traumatic experiences and the MAOA-L genotype independently result in a higher probability of severe aggression. Early recognition of childhood adversity is of extreme importance; identifying and targeting interventions to risk populations could help to reduce the development of escalated aggression later in life. Additionally, prospective research with larger sample sizes is needed to elucidate, in further detail, the complex association between genetic predisposition and aggressive behavior.
References


Chapter 5

Examining the Reactive Proactive Questionnaire in Adults in Forensic and Non-Forensic Settings: A Variable- and Person-Based Approach

Introduction

Interpersonal aggression is a worldwide problem and, according to the World Health Organization, one of the main causes of death for people between 15-44 years old (WHO, 2007). The consequences of aggression are, however, much broader than physical injuries and death. Victims of violence are at high risk of developing psychological problems, ranging from posttraumatic stress disorder to depression, anxiety disorders, substance abuse and suicidal behavior (Krug, Mercy, Dahlberg, & Zwi, 2002). On the other hand, individuals who show aggressive and violent behavior are also characterized by multiple (social) problems, such as isolation, greater legal costs and absenteeism from work (WHO, 2007). A better understanding of the taxonomy of aggression is necessary to develop and improve prevention and intervention strategies.

Aggression is defined as any behavior directed to another person with the intention to cause harm (Anderson & Bushman, 2002). It can be divided into different subtypes: for example, hostile vs. instrumental (Anderson & Bushman, 2002) and impulsive vs. premeditated (Berkowitz, 1993). Another distinction often made is the bimodal classification between reactive and proactive aggression (Dodge & Coie, 1987). Reactive aggression refers to hostile and angry responses to provocation, frustration, or threat, and has its roots in the frustration-anger model of Berkowitz (1962). Proactive aggression is described as deliberate behavior to achieve a goal or personal gain (e.g., money, power) and stems from the social-learning theory of Bandura (1973).

The overall correlation between the two forms of aggression is high ($r = .64$) according to a meta-analysis that included 51 studies on reactive and proactive aggression in children and adolescents (Polman et al., 2007). This suggests that reactive and proactive aggressive behaviors are overlapping constructs. Despite criticism of the distinction between reactive and proactive aggression due to high overlap (Bushman & Anderson, 2001), there is considerable support for unique causes and outcomes related to reactive versus proactive aggression (Baş & Yurdabakan, 2012; Crick & Dodge, 1996; Fung, Raine, & Gao, 2009; Little, Henrich, Jones, & Hawley, 2003; Merk, Orobio de Castro, Koops, & Matthys, 2005; Poulin & Boivin, 2000). For instance, proactive aggression is linked to problems in peer-relations, impairments in executive functioning, and higher cortisol levels, whereas reactive aggression is associated with low physiological arousal, lack of moral emotions and is an early risk factor for delinquent behavior in adolescence (Cima & Raine, 2003; Polman et al., 2007). These results suggest clinical relevance of the distinction between reactive and proactive aggression.

Abstract

The Reactive Proactive Questionnaire (RPQ) was originally developed to assess reactive and proactive aggressive behavior in children. Nevertheless, some studies have used the RPQ in adults. This study examines the reliability of the RPQ within an adult sample by investigating whether reactive and proactive aggression can be distinguished at a variable- and person-based level. Male adults from forensic samples ($N = 237$) and from the general population ($N = 278$) completed the RPQ questionnaire. Variable-based approaches, including factor analyses, were conducted to verify the two-factor model of the RPQ and to examine alternative factor solutions of the 23 items. Subsequently, a person-based approach, i.e. Latent Class Analysis (LCA), was executed to identify homogeneous classes of subjects with similar profiles of aggression in the observed data. The RPQ proved to have sufficient internal consistency. Multiple-factor models were examined, but the original two-factor model was statistically and theoretically considered as most solid and in line with previous research. The multi-level LCA identified three different classes of aggression severity (class 1 showed low aggressive behavior, class 2 subjects displayed modest aggression levels and class 3 exhibited the highest level of aggressive behavior). In addition, class 1 and 2 showed more reactive than proactive aggression, whereas class 3 displayed comparable levels of reactive/proactive aggression. The RPQ appears to have clinical relevance for adult populations in the way that it can distinguish severity levels of aggression. Before the RPQ is implemented in adult populations, norm scores need to be developed.
The described reactive-proactive distinction of aggression was first examined in a sample of elementary-school children (Dodge & Coie, 1987). Following this study, a large number of subsequent studies supported the existence of reactive and proactive aggression in children and adolescents in different cultures and contexts (e.g., Baş & Yurdabakan, 2013; Colins, 2015; Fossati, et al. 2009), often using the Reactive Proactive Aggression Questionnaire (RPQ) designed by Raine et al. (2006). Recently, the RPQ is even used in adults to assess the levels of reactive and proactive aggressive behavior (Cima & Raine, 2009; Lobbestael, Cima, & Arntz, 2013). Since the RPQ was originally developed for use with children, this raises the question whether the RPQ is a valid and reliable measure for use with adults.

Recently, a validation study of the RPQ in children (N=324), juveniles (N=188) and adults (N=334) was published (Cima, Raine, Meesters, & Popma, 2013). It appeared that adult prisoners scored significantly higher on both reactive and proactive aggression than non-offender adults. In addition, a variable-based approach (using a factor analysis to examine the association between unique items and underlying factors) on the items of the RPQ showed a distinction between the items representing reactive versus proactive aggression. Although the study by Cima et al. (2013) seemed to show support for the bimodal classification system of the RPQ within adults, there are two main reasons to doubt the applicability of the RPQ to adults. First, the full sample, including children, adolescents and adults, was used for the factor analysis. Therefore, it remains unclear whether the two-factor model of the RPQ is also applicable to adults only. Second, the statistical fit of the two-factor model was stronger than a one-factor model, but did not represent a robust model. Additional multiple-factor models, e.g., a three-factor model, were not explored. The results of the two-factor model of the RPQ in adults in the study of Lobbestael, Cima, and Arntz (2013) also raised further questions, since an exploratory factor analysis (EFA, varimax rotation, extracting two factors) showed that only a subset of items adequately differentiated between the two subscales. To our best knowledge, no other research exists on the factor structure of the RPQ in an adult sample by using an EFA to explore the possibility of a multiple-factor model other than a two-factor model.

A more recent paper by Smeets et al. (2016) investigated the distinction between reactive-proactive aggression in adolescents at-risk for aggressive behavior, using the RPQ. They found evidence that a three-factor model provided the best fit compared to a one-factor and a two-factor model. According to this three-factor model, reactive aggression in adolescents was best described by two constructs, namely reactive aggression due to internal frustration and reactive aggression due to external provocation. The results of Smeets et al. (2016), together with the limitations of the study by Cima et al. (2013), suggest that there is a need to investigate whether the RPQ is a reliable instrument to distinguish reactive and proactive aggression among adults.

In addition, Smeets et al. (2016) used a person-based approach to assess whether subgroups of participants existed with a distinctive aggression pattern. Using a combination of a variable-based and person-based approach is of great importance for clinical practice, as it enables one to make assumptions on the level of the group as well as the individual. Unexpectedly, their results provided no support for a clear distinction between reactive and proactive aggression. However, four classes of individuals were found based on the level of severity of aggressive behavior. Although Cima et al. (2013) showed that adult offender samples, on average, scored higher on both reactive and proactive aggression than non-offender adults, the study does not give insight in different individual patterns of aggressive behavior. Therefore, several questions still remain. For instance, is it possible to differentiate individuals with predominantly proactive or reactive aggression or should we focus on their overall level of severity of aggression? In the current study, we therefore used a combination of a variable-based and person-based approach to answer our research questions.

Box 1. Variable versus person-based approach

A variable-based approach regards to associations among variables, here the focus is on processes that are assumed to be present to a comparable degree in all members of a group. In other words, variable-based analyses, such as the factor analysis in the current study, are analyses that treat each variable as related to each other. For example, it investigates to what extent reactive aggression is related to proactive aggression.

The person-based approach, on the other hand, examines how these variables group within individuals. Thus, it concerns individual differences; the focus is on processes that are assumed to be specific to individuals who share particular characteristics (Laursen, Furman, & Mooney, 2006). In the current study, latent class analysis is employed to investigate how reactive and proactive aggression cluster within individuals.
In line with previous research, we predicted that proactive and reactive aggression forms are distinguishable in a sample consisting of adults from forensic and non-forensic settings. Second, in line with Smeets et al. (2016), it was predicted that LCA would yield four different classes of individuals (one with low reactive/proactive aggression, one with predominantly proactive aggression, one with predominantly reactive-only, and one with high reactive/proactive aggression).

Method

Participants

In order to create a large-scale and a diverse research sample, data from 515 male adults collected in several Dutch studies were aggregated. Of the full sample, 237 individuals were consecutively recruited in forensic psychiatric in- and outpatient clinics and in prisons (‘forensic sample’) and 278 individuals were recruited from the general population (‘non-forensic sample’). The age ranged from 18 to 63 years (M = 28.52, SD = 10.82). Details with regard to the recruitment of participants from forensic settings are described elsewhere (Brugman, et al., 2016; Cornet, van der Laan, Nijman, Tollenaar & de Kogel, 2015; Smeijers, Rinck, Bulten, & Verkes, submitted). All non-forensic participants were recruited at Maastricht University using flyers, posters and a student-participation system. Some participants were recruited via a list of persons who had previously participated in other studies of Maastricht University. Participation was voluntary and they all received a small financial compensation (i.e., study credits or gift vouchers). Details with regard to the recruitment of the non-forensic sample can be found elsewhere (Brugman et al., 2016; Cornet, van der Laan, Nijman, Tollenaar & De Kogel, 2015; Smeijers, Rinck, Bulten, v.d. Heuvel, & Verkes, submitted). For all studies, research approval was received from Ethical Committees. Descriptives of the sample can be found in Table 1.

Materials

Reactive Proactive Questionnaire (RPQ). The RPQ (Raine et al., 2006) is a 23-item self-report questionnaire designed to measure reactive aggression (RA) versus proactive aggression (PA) in children and adolescents. The reactive subscale consists of 12 items, whereas the proactive subscale consists of 11 items. The items are rated 0 (never), 1 (sometimes) or 2 (often). These subscales represent a two-factor model with acceptable fit indices in adolescents, based on data from the USA (Raine et al., 2006). A study on the Dutch version of the RPQ showed good internal consistency, an adequate convergence criterion and a construct validity in a sample with children, adolescents and adults (Cima & Raine, 2009).

Data Analysis

First, the internal reliability of the RPQ in the current sample was investigated using Cronbach’s alpha analysis. In addition, a Confirmatory Factor Analysis (CFA) was used to verify the two-factor model of the RPQ (Raine et al., 2006) and an Exploratory Factor Analysis (EFA) was conducted to examine alternative factor solutions of the 23 items of the RPQ using Mplus 6.11. Subsequently, a multi-level Latent Class Analysis (LCA) was conducted. This analysis considers within-center measurement bias, by using the factor solution of the RPQ and the forensic versus non-forensic groups as input. LCA is a cluster analysis that is used to identify homogeneous classes of subjects with similar profiles of aggression in the observed data. Furthermore, repeated-measures ANOVA was used to assess differences between reactive and proactive subscales across different classes.

Fit Indices

Multiple fit indices were used to interpret the results of the EFA, the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the Comparative Fit Index (CFI; Bentler, 1990), the Root Mean Square Error of approximation (RMSEA; Steiger, 1990), and the eigenvalue. Both a TLI and CFI between 0.90 and 1.00 display an acceptable to good fit of the model. An RMSEA of 0.06 or lower and an eigenvalue of 1 or higher indicate a good model fit. A factor loading of...
≤ 0.4 indicates a strong factor loading (Field, 2013). Furthermore, the Bayesian Information Criteria (BIC; lowest) and Entropy (highest) were used to define the best LCA fit. The total participants in each class should be higher than the used parameters in the model.

**Results**

**Internal Consistency RPQ**

To investigate the internal consistency of the RPQ items in the current sample, Cronbach’s α-values were calculated. The two original subscales showed good internal reliability; Cronbach’s α was .851 for proactive aggression, and .847 for reactive aggression. Both subscale scores were strongly correlated ($r = .69, p<0.001$). The corrected item total correlations of item 10 (hurt others to win a game), 13 (gotten angry or mad when you lost a game) and 18 (made obscene phone calls for fun) were below .40, indicating that these items should be interpreted with caution.

**Factor Analysis on RPQ Items**

A CFA was conducted to replicate the original two-scale factor solution of the RPQ (Raine et al., 2006). The CFA showed an acceptable fit (RMSEA 0.067-0.077, CFI = .920, TLI = .911). To examine whether three or more factors showed a better fit of the data, an EFA was conducted. Results of the EFA are shown in Table 2. A solution of four factors showed a better fit compared to two or three factors (RMSEA <0.06 and highest TLI/CFI). However, this four-factor model indicated that several items could be assigned to multiple factors (see supplementary material for the item factor loadings of the four-factor model). Since the two-factor model shows a reasonable fit and is in line with previous research regarding the original constructs of proactive and reactive aggression, this model was considered as the most adequate representation of the structure of the RPQ.

Table 2. Fit Indices of Exploratory Factor Analysis Based on RPQ

<table>
<thead>
<tr>
<th>Factor structure</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
<th>Eigen-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 factors EFA</td>
<td>0.919</td>
<td>0.933</td>
<td>0.063-0.074</td>
<td>1.929</td>
</tr>
<tr>
<td>3 factors</td>
<td>0.956</td>
<td>0.967</td>
<td>0.044-0.057</td>
<td>1.561</td>
</tr>
<tr>
<td>4 factors</td>
<td>0.974</td>
<td>0.983</td>
<td>0.032-0.046</td>
<td>1.664</td>
</tr>
<tr>
<td>5 factors</td>
<td>0.982</td>
<td>0.989</td>
<td>0.024-0.040</td>
<td>0.915</td>
</tr>
</tbody>
</table>

Note. EFA = Exploratory Factor Analysis, TLI = Tucker-Lewis Index, CFI = Comparative Fit Index, RMSEA = Root Mean Square Error of Approximation. A CFI and TLI between .90 and 1, RMSEA value of .06 or lower and an Eigen-value of >1 indicates a good model fit.

Figure 1. Structured model showing the relationship between the two studies and the three classes of aggression severity (class 1 = low aggressive traits, class 2 = medium aggressive traits, class 3 = severe aggressive traits), related to subtypes of aggressive behavior as resulted from factor analyses. Note that the original reactive/proactive aggression factors were confirmed and that class 1 and class 2 were characterized by more reactive aggression than proactive aggression (dotted lines).

Figure 2. Derived classes of the multi-level LCA with correcting for forensic vs. non-forensic sample.
Multi-level Latent Class Analysis

A multi-level Latent Class Analysis was conducted and three classes were derived (see Figure 1 and Figure 2), based on the best fit of the model (BIC) and the best fit of the individual distribution into a specific class (Entropy) (See Table 3). Post-hoc test indicated a difference between classes based on the severity of aggression (Class 3 > Class 2 > Class 1, see Table 4). Moreover, class one predominantly included individuals from the general population, whereas class three included solely individuals from forensic settings. The three different classes did not differ in age.

Table 3. Fit indices of the Latent Class Analysis

<table>
<thead>
<tr>
<th>Amount of classes</th>
<th>BIC</th>
<th>Entropy</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two classes</td>
<td>6167.01</td>
<td>950</td>
<td>N per class &gt; amount of parameters</td>
</tr>
<tr>
<td>Three classes</td>
<td>6048.57</td>
<td>943</td>
<td>N per class &gt; amount of parameters</td>
</tr>
<tr>
<td>Four classes</td>
<td>5894.64</td>
<td>932</td>
<td>N per class &lt; amount of parameters</td>
</tr>
</tbody>
</table>

Note. The lowest BIC and highest Entropy are indicators of a good fit. Furthermore, the N per class should be bigger than the amount of parameters. BIC = Bayesian Information Criteria.

Table 4. Demographic Characteristics of the Three Classes Derived From the Latent Class Analysis

<table>
<thead>
<tr>
<th>Age (SD)</th>
<th>Sample %</th>
<th>RA (SD)</th>
<th>PA (SD)</th>
<th>Within-class comparison RPQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1 (N=376)</td>
<td>28.27 (11.22)</td>
<td>1 = 64.6%</td>
<td>2 = 35.4%</td>
<td>6.91 (3.21) 1.58 (1.45) RA &gt; PA p &lt; .001</td>
</tr>
<tr>
<td>Class 2 (N=122)</td>
<td>28.86 (9.75)</td>
<td>1 = 28.7%</td>
<td>2 = 71.3%</td>
<td>13.13 (3.54) 7.48 (2.25) RA &gt; PA p &lt; .001</td>
</tr>
<tr>
<td>Class 3 (N=17)</td>
<td>31.47 (9.2)</td>
<td>1 = 0.0%</td>
<td>2 = 100%</td>
<td>17.68 (3.53) 16.35 (2.8) RA = PA p &lt; .001</td>
</tr>
<tr>
<td>Between-class comparison p = .454 p &lt; .001 p &lt; .001 1 &lt; 2 &lt; 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. RA = Reactive Aggression, PA = Proactive Aggression, RPQ = Reactive Proactive Questionnaire.
*1 = non-forensic sample; 2 = forensic samples.

Discussion

In the current study, the reliability of the RPQ in adults from a forensic and non-forensic sample was examined. The results revealed two main findings: (i) the variable-based approach revealed sufficient internal consistency and acceptably supported the original two-factor model; and (ii) the person-based approach revealed three classes of individuals based on severity of aggression rather than on different subtypes of aggression. These results are discussed in further detail.

First, the results of the factor analyses revealed that proactive and reactive aggression were distinguishable in an adult sample. The fit indices of the two-factor model showed comparable fit to the results of several other studies (Baş & Yurdabakan, 2012; Cima et al., 2013; Fung et al., 2009; Raine et al., 2006). However, the current study additionally examined alternative factor solutions by using an EFA, which, to our knowledge, has never been used before regarding the RPQ in an adult sample. Previously, other factor solutions have been investigated with respect to children (Tuvblad, Dhamija, Berntsen, Raine, & Liu, 2015). Regarding adults, on the other hand, previous research mainly focused on investigating a one-factor model in comparison with a two-factor model. The results of both CFA and EFA analyses did not show clear evidence for bimodal classification. Up to a four-factor model the fit indices of the EFA improved, suggesting that aggressive behavior could be classified into four subtypes.

To analyze whether the three different classes differ in their pattern of proactive and reactive aggression a 2 (aggression: proactive, reactive) x 3 (class: 1, 2, 3) repeated-measures ANOVA was conducted. Significant main effects of aggression and group and a significant aggression x group interaction were found, F(1, 504) = 188.90, p < .002, eta² = .273; F(2, 504) = 615.81, p < .001, eta² = .710; and F(2, 504) = 13.37, p < .001, eta² = .050, respectively. The results indicate that overall the levels of proactive and reactive aggression differ from each other. Moreover, all classes differed significantly from one another regarding the proactive and reactive aggression scale. Finally, the classes differ in their pattern of proactive and reactive aggression in the way that class 3 exhibits comparable levels of reactive and proactive aggression, whereas class 1 and 2 display more reactive than proactive aggressive behavior.
Based on the distribution of items, we propose a potential interpretation of the four factors: (i) impulsive-reactive aggression in reaction to frustration or provocation, (ii) instrumental, proactive aggression, (iii) aggression in the context of playing games, and (iv) reactive, defensive aggression. This model shows that, in addition to the two original factors (reactive vs proactive), there are two other, more specific forms of aggressive behavior (in the context of playing games and a defensive form). Nevertheless, within the four-factor model, 10 items load marginally (> .3) on more than one factor. This indicates that statistically there might be a four-factor model, but interpretation of the four factors should be considered as theoretically less solid as several items refer to different aggressive behavior traits. On the other hand, the results of the two-factor model also showed acceptable fit indices, although somewhat lower than the four-factor fit indices. In addition, the two-factor model demonstrated that items were more uniquely associated with either reactive or proactive aggressive behavior traits. All in all, we considered the original two-factor model to be statistically and theoretically more solid than the four-factor model.

Second, in contrast to the expectations, the person-based approach revealed three distinct classes that were not characterized by different aggression profiles; the classes were based on a combination of both reactive and proactive aggression. Compared to the other classes, class 1 and class 2 were characterized by low proactive/high reactive aggression and class 3 was characterized by relatively high proactive/high reactive aggression. These results might suggest that either proactive aggression does not occur without reactive aggression, or that the RPQ is not able to identify groups showing solely proactive aggression. Previous studies, which showed that proactive aggression is a unique predictor of future delinquent behavior (Breiden, Vitaro, Tremblay, & Lavoie, 2003; Vitaro, Gendreau, Tremblay, & Oligny, 1998), indicating that a subgroup displaying solely proactive aggressive behavior may exist. However, based upon the data, conclusive decisions on whether the RPQ is able to identify a subgroup of proactive aggressive adults or whether such a group exists, cannot be made. In the present study, no other measures of aggressive behavior were included. Therefore, it was not possible to test whether other aggression instruments do identify a subgroup of solely proactive aggressive adults or that this group is non-existent in adults. Future research on this topic should include multiple aggression instruments to answer this question. The most severe class, revealed by the LCA, displayed very high scores on proactive aggression. However, this specific class consisted of a very small sample and therefore, the results need to be interpreted with care.

In sum, the results of the LCA analysis demonstrated the discriminative power of the RPQ in a forensic and non-forensic sample as class 1 predominantly included individuals from the general population, whereas class 3 included solely individuals from forensic settings. However, this distinction is mainly based upon the severity level of aggression and not on distinctive patterns of reactive and proactive aggression. This may be in line with literature that suggests a general psychopathological factor that underlies all forms of psychopathology (Caspi et al., 2014). These authors assert that the general underlying dimension summarizes individuals’ tendency to develop any and all forms of common psychopathologies. Regarding aggressive behavior, one might argue that there is one overriding aggression factor that displays a general tendency to develop aggressive behavior irrespectively of aggression subtype (reactive/proactive) and which, therefore, merely is displayed in terms of severity.

The present study is characterized by several strong points. First, the current sample consisted of a relatively large adult sample compared to other similar studies (Cima & Raine, 2009). Moreover, various samples were included (forensic psychiatric in- and outpatient clinic, offenders and general population), which enables generalizability to a large population of male adults. Another important asset of this study is the fact that multiple-factor models were explored in addition to the existing two-factor model of the RPQ, as alternatives for this bimodal distinction have not often been explored in research.

Although the current study extends the knowledge on the applicability of the RPQ within adult samples, a number of limitations have to be considered regarding the current study. First, this study included only male participants. More research is needed on the reliability and concurrent validity of the RPQ among female participants. Second, the RPQ is a self-report measure of aggressive behavior, which might be biased due to lack of insight or social desirable answering (Vigil-Colet, Pamies, Carrasco, & Seva, 2012). It is possible that social desirability in this sample suppressed self-reported aggression overall, or that one of the two forms of aggression is less reported as it is seen as a less socially desirable form of behavior (e.g., proactive aggression). Further, the external validity of either the factors or the classes was not examined. Also, future research should look into the association between currently found factors and/or the classes and external behavioral measures, for example, psychopathy and impulsivity. In addition, future studies on applicability of the RPQ in adult sample should include other self-report instruments on aggression to be able to compare the reliability and validity of these instruments among adults. Nevertheless, the RPQ is very time-efficient, easy to administer and score, making it possible to give (some) insight into aggressive behavior patterns of patients rather effortlessly.
Overall, this study adds to the knowledge of the reliability of the RPQ in (male) adult populations. The findings show that the RPQ appears to be reliable for male adult samples and can be used in clinical practice to distinguish subgroups with clinical and non-clinical levels of aggression. This distinction is based upon the severity of reported aggression and not upon the type of aggression, which gives an estimation on which subgroup needs less intensive interventions and which group benefits best from a more intensive treatment. Currently, norm scores are not available for the RPQ. The mean scores of our classes may serve as potential indicators of clinical severity of aggression. However, in order to use this instrument in clinical practice at an individual level, norm scores need to be developed using larger sample sizes. The influence of age on the development of aggression must be taken into account when developing norm- and cut-off scores. Moreover, extension of knowledge is also needed on the characteristics of the subgroups that have been found with the RPQ in this research (e.g. neurocognitive functioning, behavioral traits, and genetics).

References


Lobbestael, J. The correspondence between behavioral and self-reported aggression. In preparation.


Chapter 6

Lack of Correspondence Between the Reactive Proactive Questionnaire and the Impulsive Premeditated Aggression Scale among Forensic Psychiatric Outpatients

Smeijers, D., Brugman, S., von Borries, K., Verkes, R.J., & Bulten, E. Lack of Correspondence Between the Reactive Proactive Questionnaire and the Impulsive Premeditated Aggression Scale among Forensic Psychiatric Outpatients. (Submitted).
Abstract

The most studied bimodal classifications of aggressive behavior are the impulsive/premeditated distinction measured with the Impulsive Premeditated Aggression Scale and the reactive/proactive distinction measured with the Reactive Proactive Questionnaire. The terms of these classifications are often used interchangeably, assuming that reactive aggression is equivalent to impulsive aggression and that proactive aggressive behavior is the same as premeditated aggression. The correspondence or discrepancy between both aggression classifications/questionnaires, however, is understudied. Therefore, the current study investigated the correspondence between the RPQ and IPAS in a sample of 163 forensic psychiatric outpatients (FPOs) with severe aggressive behavior. Correlation analysis revealed a limited correspondence between the RPQ and IPAS (r ranging from .30 to .55). Cluster analyses derived three clusters from the RPQ as well as the IPAS, these clusters did not match in 60.3% of the cases. Furthermore, the notion that the RPQ measures trait aggression whereas the IPAS assesses state aggression could not be verified. The present study indicates that aggression subtypes as measured by use of the RPQ and IPAS correspond only partially and should not be used interchangeably. Furthermore, it was suggested that the RPQ focuses more on actual aggressive behavior and the IPAS more on emotions and their regulation. Future research is needed to elucidate the applicability of both questionnaires in further detail.

Introduction

To understand the underlying mechanisms of aggressive behavior, in clinical practice as well as in scientific research, the following distinction between two main aggression subtypes is often made: 1) spontaneous lack of behavioral control, and emotionally driven responses to threat, frustration or provocation, which has been referred to as reactive, impulsive, affective, or hostile aggression, versus 2) planned and deliberate, in the absence of emotions, and goal directed responses, which has been called proactive, premeditated, predatory, or instrumental aggressive behavior (Anderson & Bushman, 2002; Weinshenker & Siegel, 2002). The importance of a bimodal classification of aggressive behavior is supported by research which revealed that the subtypes of aggression have different emotional, neurobiological and behavioral causes and consequences (e.g. Babcock, Tharp, Sharp, Hepgner, & Stanford, 2014; Cima & Raine, 2009; Polman, de Castro, Koops, van Boxtel, & Merk, 2007). Reactive/impulsive/affective/hostile aggression is linked to poor social adjustment and emotion regulation, hostile attribution biases, problems in peer-relations, and impairments in executive functioning whereas proactive/premeditated/predatory/instrumental aggressive behavior is associated with reduced emotional reactivity, low physiological arousal, lack of moral emotions, and it predicts later delinquency (Babcock et al., 2014; Cima & Raine, 2009; Polman et al., 2007). These differences have implications regarding prevention, diagnosis, and treatment (Babcock et al., 2014). For clinical practice it is, therefore, of great importance to classify patients correctly.

The most studied bimodal classifications of aggressive behavior are the impulsive/premeditated and the reactive/proactive distinction. The terms of these classifications are often used interchangeably, assuming that reactive aggression is equivalent to impulsive aggression and that proactive aggressive behavior is the same as premeditated aggression. In favor of this assumption, the review by Babcock et al. (2014) showed that there is overlap between proactive and premeditated aggression regarding associations with psychopathy, impulsivity and psychophysiology. Between reactive and impulsive aggression overlap has been found on correlations with poor social adjustment and emotional outcomes, attentional problems, and psychopathy. Despite this overlap, also some divergence has been found, for instance proactive aggression is thought to be associated with a lack of prosocial behavior and reduced emotional reactivity whereas such associations are not found/less clear regarding premeditated aggression. Also divergence regarding reactive and impulsive aggression has been reported: substance use and delinquency correlated with impulsive aggression, whereas no or only indirect associations
were found with reactive aggression. Based on the empirical overlap and divergence of the subtypes Babcock et al. (2014) suggests that there is more correspondence between reactive and impulsive aggression than between proactive and premeditated aggression.

Babcock et al. (2014) further suggests that the two bimodal classifications are conceptually and empirically distinctive. They differ in how the subtypes are defined: Reactive aggression refers to impulsive, angry or defensive responses to threat, frustration or provocation, whereas impulsive aggression is characterized by loss of behavioral control and is emotionally driven. Proactive aggression on the other hand, refers to manipulative, callous and deliberate behavior which is often driven by the obtainment of personal goals or gains, whereas premeditated aggression is often described as planned or conscious behavior, not accompanied by autonomic arousal. Furthermore, Babcock et al. (2014) asserted that there are slight differences in the definitions which suggest that the impulsive/premeditated aggression classification stresses what occurs during the aggressive act whereas the reactive/proactive distinction also includes characteristics of the individual.

In line with the differences in definition, different instruments to measure the two bimodal classifications are used: The Reactive Proactive Questionnaire (RPQ) to assess reactive/proactive aggression and the Impulsive Premeditated Aggression Scale (IPAS) to measure impulsive/premeditated aggression. These questionnaires tend to differ in their instructions, item content and scoring (Babcock et al., 2014). For instance, high scores on the RPQ are based on frequency of acting out in anger whereas the IPAS reflects mood at the time of the aggressive act. Additionally, the RPQ was originally developed to distinguish reactive and proactive aggressive behavior in children and adolescents but is also frequently used among adults whereas the IPAS was developed for use in adults. Based on the differences regarding instructions, concept definition and population for which it was developed Babcock et al. (2014) suggest that the RPQ assesses trait aggression in children and the IPAS state aggression in adults. These differences may indicate a discrepancy between the bimodal classifications suggesting that they might not be used interchangeably. A non-correspondence between the most frequently used bimodal classification measures has implications for the generalizability of research findings for one subtype to another and for its application in clinical settings.

The correspondence or discrepancy between both aggression questionnaires, however, is understudied. To date, only one study aimed to investigate this issue with use of a person based approach which examines how the questionnaires group/classify individuals (Laursen, Furman, & Mooney, 2006). The study by Tharp et al. (2011) followed such a person-based approach by use of a cluster analysis to detect naturally occurring groups based on the subscale scores. Their results showed that the correspondence between the RPQ and IPAS, in a student sample, was limited; only 37.6% of the cases were classified similarly by both questionnaires. The authors suggest that the RPQ and IPAS differ in how they identify and conceptualize proactive/premeditated and reactive/impulsive aggressive behavior. As this is the only study which investigated the correspondence between both bimodal classifications, it is of importance to further elucidate the applicability of both questionnaires in aggressive samples.

The current study aimed to investigate the correspondence between the RPQ and IPAS in a sample of forensic psychiatric outpatients (FPOs) with aggression regulation problems. More specifically, it was tested whether FPOs will be classified similarly with the RPQ and the IPAS using a person based approach. In line with the study by Tharp et al. (2011) it was hypothesized that the correspondence between both questionnaires was limited but higher between reactive and impulsive aggression than between proactive and premeditated aggression. Furthermore, it was hypothesized that the RPQ was more strongly related to measures of trait aggression whereas the IPAS was hypothesized to be more strongly associated with measures of state aggression. As the RPQ and the IPAS are developed for usage in different age samples, it was explored whether the questionnaires were reliable in subgroups of FPOs with different age ranges.

**Method**

**Participants**

One-hundred-sixty-one male forensic psychiatric outpatients (FPOs) diagnosed with aggression regulation problems participated in this study. The FPOs were recruited among patients admitted to “Kairos”, secondary care and outpatient unit of Forensic Psychiatric Center the Pompestichting in Nijmegen, The Netherlands. The FPOs included in the present study were admitted to Kairos because of aggression regulation problems. Admission to Kairos occurs on either obligatory (when sentenced by a judge) or voluntary basis (based on reference by general practitioner which is necessary in secondary care). One-hundred-eighteen patients were referred voluntarily and 43 obligatory.

The FPOs were screened by trained clinicians with the Structured Clinical Interview for DSM-IV axis II personality disorders (Weertman, Arntz, & Kerkhofs, 2000) and the Research Criteria set for Intermittent Explosive Disorder (Coccaro, Kavoussi, Berman, & Lish, 1998). Inclusion to the study required FPOs to comply with the following criteria:
form the subscale scores. A study on the Dutch version of the RPQ showed good internal consistency and adequate convergence criterion and construct validity in a sample with children, adolescents and adults (Cima, Raine, Meesters, & Popma, 2013). As suggested by Cima et al. (2013) and Raine et al. (2006) the residualized measures of both subscales of the RPQ were created in order to assess the correlates of reactive and proactive aggression independently of one another. Reactive aggression was regressed on proactive scores and Pearson standardized residuals (with a mean of 0 and SD of 1) were saved to index residualized proactive aggression, while the standardized residuals of proactive aggression on reactive aggression were saved to index residualized reactive aggression. Both the raw and residualized measures were used.

Impulsive Premeditated Aggression Scale (IPAS; Stanford et al., 2003) is a 30-item self-report measure to assess impulsive aggression versus premeditated aggression during the last six months. The impulsive subscale consists of 10-items (e.g. when angry, I reacted without thinking) whereas the premeditated subscale consists of 8-items (e.g. I think the other person deserved what happened to them during some of the incidents). The subscale items are summated to form the subscale scores. Twelve items are not subdivided into either of the two subscales. Items are rated on a 5-point Likert scale with 0 = strongly disagree and 5 = strongly agree as extremes. The original IPAS as well as the Dutch version has proven validity and reliability (Kuyck, de Beurs, Barendregt, & van den Brink, 2013; Stanford et al., 2003).

The Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990) is an observer-scale that measures the severity of actual aggressive behavior. It consists of nine items measuring outward aggression and two items measuring inward aggression. Items have to be scored on a 4-point Likert scale with 0 = not present and 4 = severely to extremely present as extremes. The SDAS has adequate observer reliability (Wistedt et al., 1990). In the current study, due to lack of observers, the SDAS was used as self-report. Participants had to rate their aggressive behavior over a period of three months. In addition, FPOs were excluded if there was a current major depression, current severe addiction or lifetime bipolar disorder or any psychotic disorder. To verify that none of the FPOs met the exclusion criteria they were screened with the MINI International Neuropsychiatric Interview (Sheehan et al., 1998; Van Vliet & De Beurs, 2007). The total duration of the assessment was approximately 45 minutes and the study was approved by the Medical Research Ethics Committee (CMO region Arnhem-Nijmegen, The Netherlands). All participants signed a consent form after receiving information about the study and obtained a monetary compensation. Demographic information is provided in Table 1.

Table 1. Demographic information

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>Mean / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>36.07 (10.86)</td>
</tr>
<tr>
<td>IQ*, mean, (SD)</td>
<td>87.87 (12.11)</td>
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<td>Diagnosis, N, (%)</td>
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<td>Antisocial personality disorder</td>
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<td>Borderline personality disorder</td>
<td>28 (17.4)</td>
</tr>
<tr>
<td>Narcissistic personality disorder</td>
<td>6 (3.7)</td>
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<tr>
<td>Intermittent explosive disorder</td>
<td>138 (85.7)</td>
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<td>ADHD</td>
<td>44 (27.3)</td>
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<tr>
<td>History of depressive disorder</td>
<td>101 (52.8)</td>
</tr>
</tbody>
</table>

*as measured by using the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991).

Measures

The Reactive Proactive Questionnaire (RPQ; Raine et al., 2006) is a 23-item self-report questionnaire to assess reactive aggression versus proactive aggression in children and adolescents. The reactive subscale consists of 11 items (e.g. how often have you reacted angrily when provoked by others) whereas the proactive subscale consists of 12 items (e.g. how often have you used physical force to get others to do what you want). The items are rated 0 (never), 1 (sometimes) or 2 (often). The subscale items are summated to

1) a diagnosis of an antisocial, borderline and/or narcissistic personality disorder, and/or intermittent explosive disorder (IED), and 2) have a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). The SDAS measures the severity of current aggressive behavior based on a 5-point rating scale, and can be completed by an observer or by the patient. In this study, due to lack of observers, the SDAS was used as a self-report instrument. Aggressive behavior was rated by each FPO over a period of three months. In addition, FPOs were included if there was a current major depression, current severe addiction or lifetime bipolar disorder or any psychotic disorder. To verify that none of the FPOs met the exclusion criteria they were screened with the MINI International Neuropsychiatric Interview (Sheehan et al., 1998; Van Vliet & De Beurs, 2007). The total duration of the assessment was approximately 45 minutes and the study was approved by the Medical Research Ethics Committee (CMO region Arnhem-Nijmegen, The Netherlands). All participants signed a consent form after receiving information about the study and obtained a monetary compensation. Demographic information is provided in Table 1.

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<tr>
<th>Descriptives</th>
<th>Mean / N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>36.07 (10.86)</td>
</tr>
<tr>
<td>IQ*, mean, (SD)</td>
<td>87.87 (12.11)</td>
</tr>
<tr>
<td>Diagnosis, N, (%)</td>
<td></td>
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<tr>
<td>Antisocial personality disorder</td>
<td>67 (41.6)</td>
</tr>
<tr>
<td>Borderline personality disorder</td>
<td>28 (17.4)</td>
</tr>
<tr>
<td>Narcissistic personality disorder</td>
<td>6 (3.7)</td>
</tr>
<tr>
<td>Intermittent explosive disorder</td>
<td>138 (85.7)</td>
</tr>
<tr>
<td>ADHD</td>
<td>44 (27.3)</td>
</tr>
<tr>
<td>History of depressive disorder</td>
<td>101 (52.8)</td>
</tr>
</tbody>
</table>

*as measured by using the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991).
The Non-correspondence Between RPQ and IPAS

Third, correlation analyses were conducted between the RPQ, IPAS and AQ, SDAS, SRP-SF, ZAV state and ZAV trait in order to investigate whether the RPQ is more strongly associated with trait aggression and the IPAS more strongly with state aggression. Again bootstrapping procedure was used. Fourth, Cronbach’s alpha was calculated to determine the reliability of both the IPAS and RPQ subscales. Subsequently, to explore the reliability of the RPQ and IPAS in different age groups, the FPOs were subdivided in three groups depending on age: <25 (N= 28), 25 – 40 (N= 75), >40 (N= 58). Reliability analyses were conducted again for each subscale in every subgroup.

Results

Associations between RPQ and IPAS

To explore the associations between the subscales of the RPQ and IPAS, correlation analyses were performed. First, a high inter-correlation between reactive and proactive aggression was found, \( r = .710, CI = .645 – .773, p < .001 \). This inter-correlation did not emerge regarding the impulsive and premeditated subscales of the IPAS. Therefore, regarding the IPAS, no residualized aggression measure was used, only raw scores. Subsequently, the predicted correlations of the RPQ reactive scale with the IPAS impulsive scale and the RPQ proactive scale with the IPAS premeditated scale were found. However, the correlations were weak to modest and indicate that the RPQ reactive/proactive dimension overlap only in a limited way with the IPAS impulsive/premeditated dimension. Correlations are displayed in Table 2.

Table 2. Correlations between subscales of the RPQ and IPAS

<table>
<thead>
<tr>
<th></th>
<th>RPQ Reactive raw</th>
<th>RPQ Proactive raw</th>
<th>RPQ Reactive residualized</th>
<th>RPQ Proactive residualized</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPAS Premeditated</td>
<td>( r = .379^{**} )</td>
<td>( r = .546^{**} )</td>
<td>( r = -.011 )</td>
<td>( r = .393^{**} )</td>
</tr>
<tr>
<td></td>
<td>( CI = .227 – .515 )</td>
<td>( CI = .410 – .644 )</td>
<td>( CI = -.181 – .155 )</td>
<td>( CI = .234 – .533 )</td>
</tr>
<tr>
<td>IPAS Impulsive</td>
<td>( r = .362^{**} )</td>
<td>( r = .142 )</td>
<td>( r = .286^{**} )</td>
<td>( r = -.103 )</td>
</tr>
<tr>
<td></td>
<td>( CI = .157 – .434 )</td>
<td>( CI = -.087 – .279 )</td>
<td>( CI = .147 – .400 )</td>
<td>( CI = -.344 – .031 )</td>
</tr>
</tbody>
</table>

Note: ** P < .01
CI refers to 95% confidence interval.

Statistical Analysis

First, a correlation analysis was performed on the subscales of the IPAS and RPQ (both raw and residualized scores) to explore the correspondence between the two instruments. To determine confidence intervals and to test the significance of the correlations, a bootstrapping (1000 samples) procedure was used. Bootstrapping is based on random sampling with replacement. By using bootstrapping, one is able to simulate the population distribution of the correlation and to provide confidence intervals for the correlation coefficients (Sideridis & Simos, 2010). Moreover, when using this approach a more accurate estimate of the associations is provided as compared to estimates produced by a single sample (Hesterberg, Monaghan, Moore, Clipson, & Epstein, 2003).

Second, in line with the study by Tharp et al. (2011), a person based approach was used in which two-step cluster analyses were conducted to investigate the correspondence of FPOs identified as reactive/impulsive and proactive/premeditated. This analysis is an exploratory strategy designed to reveal natural groupings within the data. One of the advantages of this method is that no a priori allocation of the number of clusters is required. In the current analyses, the number of clusters was determined automatically. The distance between variables for cluster allocation was determined using the Log-likelihood method. The clusters were subsequently compared with a MANOVA.

...
Correspondence RPQ and IPAS

Cluster analyses were conducted, separately, on the RPQ and IPAS subscale scores. The two-step cluster analysis for the RPQ revealed a fair to good fit based on a 0.6 silhouette measure of cohesion and separation. The model of the IPAS showed a fair fit based on a 0.5 silhouette measure of cohesion and separation. Both questionnaires yielded three clusters. Based on the mean, the clusters were labeled as “both high” (RPQ: high reactive/proactive; IPAS: high impulsive/premeditated), “both medium” (RPQ: medium reactive/proactive; IPAS: medium impulsive/premeditated) and “both low/mainly reactive” regarding the RPQ (i.e., low reactive/very low proactive) and “mainly impulsive” with respect to the IPAS (i.e., high impulsive/low premeditated), see Table 3. A visual representation of the clusters is provided in two scatterplots in Figure 1. Subsequently, the correspondence was examined. When the clusters were compared, the categories did not match in 60.3% (N = 64) of the cases.

To further explore the differences between the clusters found in the cluster analyses, a MANOVA was conducted in which the three clusters of the RPQ and IPAS were compared regarding the AQ, SDAS, SRP-SF and ZAV. Means and SDs for these measures per cluster are presented in Table 4. Bonferroni correction was used to control for multiple comparisons. Significant multivariate effects of RPQ cluster and IPAS cluster were found, Wilks’ Lambda = .762, \( F(10, 272) = 3.95, p < .001, \eta^2 = .127 \); Wilks’ Lambda = .758, \( F(10, 272) = 4.03, p < .001, \eta^2 = .129 \).

Group-wise comparison regarding the RPQ clusters revealed that cluster “both high” scored higher than clusters “both medium” and “both low/mainly reactive” on the AQ \( (p = .023; p < .001) \), SRP-SF \( (p = .005; p < .001) \) and ZAV trait \( (p = .022; p < .001) \) and only higher on the SDAS \( (p < .001) \) as compared to the cluster “both low/mainly reactive”. Cluster “both medium” showed higher scores on the AQ \( (p < .001) \), SDAS, \( (p = .002) \), SRP-SF \( (p = .019) \) and ZAV trait \( (p < .001) \) than cluster “both low/mainly reactive”. Group-wise comparison with regard to the IPAS clusters revealed that cluster “both high” scored higher on AQ \( (p < .001) \), SDAS \( (p = .004) \), SRP-SF \( (p < .001) \) and ZAV trait \( (p < .001) \) as compared to cluster “both medium” and scored higher only on the SRP-SF \( (p = .047) \) than cluster “mainly impulsive”. Cluster “both medium” showed lower scores on the AQ \( (p < .001) \), SRP-SF \( (p = .057) \) and ZAV trait \( (p < .001) \) as compared to “mainly impulsive”. To further explore, post hoc, the correspondence between the RPQ and IPAS domains we used a discriminant analysis to analyze to what extent the patients could be classified in the three clusters based on the IPAS by use of the RPQ subscale scores. (Given the hypothesis that the RPQ provides more trait like measures and the IPAS more state

Figure 1. Scatterplots subscales IPAS and RPQ, distribution clusters
like, we considered this the most appropriate direction: to analyze if trait could predict state. The discriminant analysis revealed two discriminant functions. The first explained 79% of the variance, canonical $R^2 = .49$, whereas the second explained 21%, canonical $R^2 = .28$. In combination these discriminant functions significantly differentiated the IPAS clusters regarding the RPQ reactive subscale and proactive subscale Wilks’ Lambda = .795, $F(2, 158) = 20.32$, $p < .001$; Wilks’ Lambda = .772, $F(2, 158) = 23.30$, $p < .001$, respectively. Of the original grouped cases 58.4% were classified correctly.

**Associations with other aggression measures**

To explore the associations between the RPQ and IPAS and measures of state and trait aggression, correlation analyses were performed. Raw reactive as well as proactive aggression was positively associated with all subscales of the AQ, all subscales of the SRP-SF, SDAS and state as well as trait aggression as measured by the ZAV. The residualized reactive aggression measure, however, was positively associated with all subscales of the AQ, only the lifestyle subscale of the SRP-SF, SDAS and ZAV trait whereas the residualized proactive aggression measure was only positively associated with all the subscales of the SRP-SF. With respect to the IPAS, impulsive aggression was positively associated with all subscales of the AQ, lifestyle subscale of the SRP-SF, SDAS and ZAV trait. Premeditated aggression was positively associated with all subscales of the AQ, all subscales of the SRP-SF, SDAS and ZAV trait. Correlations are displayed in Table 5.

Table 3. Cluster analyses

<table>
<thead>
<tr>
<th>RPQ</th>
<th>N</th>
<th>Mean reactive</th>
<th>Mean proactive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1; both high</td>
<td>25</td>
<td>M = 18.48</td>
<td>M = 12.28</td>
</tr>
<tr>
<td>Cluster 2; both medium</td>
<td>71</td>
<td>M = 14.61</td>
<td>M = 4.34</td>
</tr>
<tr>
<td>Cluster 3; both low/mainly reactive</td>
<td>65</td>
<td>M = 7.49</td>
<td>M = 1.35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IPAS</th>
<th>N</th>
<th>Mean impulsive</th>
<th>Mean premeditated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1; both high</td>
<td>66</td>
<td>M = 36.23</td>
<td>M = 25.95</td>
</tr>
<tr>
<td>Cluster 2; both medium</td>
<td>31</td>
<td>M = 27.61</td>
<td>M = 18.71</td>
</tr>
<tr>
<td>Cluster 3; mainly impulsive</td>
<td>64</td>
<td>M = 19.39</td>
<td>M = 14.91</td>
</tr>
</tbody>
</table>

Table 4. Means on questionnaires

<table>
<thead>
<tr>
<th>AQ</th>
<th>SRP-SF</th>
<th>SDAS</th>
<th>ZAV State</th>
<th>ZAV Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPQ</td>
<td>cluster 1; high reactive/proactive</td>
<td>M = 110.05 (SD = 12.78)</td>
<td>M = 97.52 (SD = 14.18)</td>
<td>M = 81.26 (SD = 16.83)</td>
</tr>
<tr>
<td>cluster 2; medium reactive/proactive</td>
<td>M = 97.52 (SD = 14.18)</td>
<td>M = 81.26 (SD = 16.83)</td>
<td>M = 101.83 (SD = 16.26)</td>
<td></td>
</tr>
<tr>
<td>cluster 3; both low/mainly reactive</td>
<td>M = 81.26 (SD = 16.83)</td>
<td>M = 101.83 (SD = 16.26)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| IPAS | cluster 1; high impulsive/premeditated | M = 101.83 (SD = 16.26) | M = 97.52 (SD = 14.18) | M = 81.26 (SD = 16.83) | M = 101.83 (SD = 16.26) |
| cluster 2; medium impulsive/premeditated | M = 97.52 (SD = 14.18) | M = 81.26 (SD = 16.83) | M = 101.83 (SD = 16.26) |
| cluster 3; mainly impulsive | M = 81.26 (SD = 16.83) | M = 101.83 (SD = 16.26) |

Note: Superscripts of mean values indicate significant group differences: Groups with different superscripts differ from each other at least $p<.05$. 

5 of the 8 differences were significant between the clusters.
The present study investigated the correspondence between the most frequently used measures to classify aggression subtypes among FPOs displaying severe levels of aggressive behavior. The results revealed that the correlations between the corresponding subscales of the RPQ and IPAS were limited and higher between proactive and impulsive aggression, the latter is contrary to our hypothesis. The correspondence of the classification based on the subscale premeditated aggression than between reactive and impulsive aggression, the latter is contrary to our hypothesis. The correspondence of the classification based on the subscale premeditated aggression than between reactive and impulsive aggression, the latter is contrary to our hypothesis. The correspondence of the classification based on the subscale premeditated aggression than between reactive and impulsive aggression, the latter is contrary to our hypothesis. The correspondence of the classification based on the subscale premeditated aggression than between reactive and impulsive aggression, the latter is contrary to our hypothesis.

Table 5. Correlations between RPQ, AQ, SDAS, SRP-SF, ZAV.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>React to Reactive raw</th>
<th>React to Reactive residualized</th>
<th>React to Preemptive raw</th>
<th>React to Preemptive residualized</th>
<th>IPAS Impulsive raw</th>
<th>IPAS Premeditated raw</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPQ Physical</td>
<td>r = .52** CI = .40 – .60</td>
<td>r = .32** CI = .25 – .40</td>
<td>r = .19** CI = .10 – .29</td>
<td>r = .20** CI = .30 – .38</td>
<td>r = .42** CI = .65 – .46</td>
<td>r = .40** CI = .35 – .45</td>
</tr>
<tr>
<td>AQ Verbal</td>
<td>r = .39** CI = .25 – .51</td>
<td>r = .39** CI = .25 – .51</td>
<td>r = .39** CI = .25 – .51</td>
<td>r = .39** CI = .25 – .51</td>
<td>r = .39** CI = .25 – .51</td>
<td>r = .39** CI = .25 – .51</td>
</tr>
<tr>
<td>AQ Anger</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
</tr>
<tr>
<td>AQ Hostile</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
<td>r = .40** CI = .29 – .51</td>
</tr>
<tr>
<td>SDAS Total</td>
<td>r = .55** CI = .76 – .78</td>
<td>r = .55** CI = .76 – .78</td>
<td>r = .55** CI = .76 – .78</td>
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Note: * P < .05; ** P < .01.
CI refers to 95% confidence interval.
Non-correspondence Between RPQ and IPAS

The lack of inter-correlation between the subscales of the IPAS might be due to the fact that scores in order to measure ‘pure’ reactive/proactive aggression independent of the other.

Because of this high inter-correlation, Raine et al. (2006) suggest to use the residualized inter-correlation found between reactive and proactive aggression (RPQ) and the lack that the IPAS assumes the presence of aggressive behavior. The items do not question aggressive acts in itself, as the RPQ does, but rather focus on whether emotions were involved and whether someone could control their impulses. Because of the presumption of the presence of aggression, the IPAS may be less suitable for use in non-aggressive individuals as stated above. Regarding the applicability of the IPAS in forensic mental health settings, on the other hand, it is questionable whether patients in this setting are able to reflect on their behavior (Schmidt, Banse, & Imhoff, 2015) and whether they have enough insight in their emotion and aggression regulation capacities.

To make a first step towards elucidating the applicability of the RPQ and IPAS among different samples exploratory analyses were conducted. These results suggested that the RPQ is appropriate for use in adult FPOs in general and in FPOs with different age groups as the reliability of both subscales remained stable. Even though the RPQ originally was developed for use in children, the current results may provide support for a reliable use in adults. This is in agreement with previous studies (e.g. Brugman, Cornet, Smeijers et al., 2016; Cima et al., 2013). The results regarding the IPAS, however, were less conclusive. In particular, the impulsive subscale showed poor reliability in FPOs within the age range between 18 and 25. A good reliability was only found among FPOs above the age of 40.

The present study and results have a number of limitations which merit further comment. First of all, the distribution of the FPOs among different age groups was unequal. Prospective research should include larger sample sizes and children as well to replicate the current findings. Second, only male FPOs participated, these results may, therefore, not be generalizable to a female population with aggression regulation problems. Moreover, as this was an explorative study the results have to be interpreted with care. No causal conclusions can be drawn from the data and more research is needed to elucidate the applicability of the RPQ and IPAS. The hypothesis that the IPAS is measuring the capacity of emotion and aggression regulation should be investigated further by making use of other materials, such as the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004).

Overall, the results may seem to suggest that aggression subtype as measured by use of the RPQ and IPAS are not equivalent. This has implications for the generalizability of research findings for one subtype to another and for its application in clinical settings. The subtypes, therefore, should not be used interchangeably. The RPQ seemed to complement previous findings by showing that classification of individuals displaying severe levels of aggressive behavior these questionnaires show only a partial overlap.

This might have important implications; the terms ‘reactive’ and ‘impulsive’ on the one hand and ‘proactive’ and ‘premeditated’ on the other should not be used interchangeably and, moreover, further knowledge is needed to make an informed decision about which questionnaire to use in for instance specific populations or age groups.

It was suggested that the RPQ measures trait aggression whereas the IPAS assesses state aggression (Babcock et al., 2014). Based on this idea, it was hypothesized that the RPQ would be more strongly associated with the AQ, ZAV trait anger and SRP-SF whereas IPAS was expected to be associated with ZAV state and SDAS. The current results, however, do not support this notion; both questionnaires were found to be positively associated with measures of trait, state and severity of aggression and psychopathy. Furthermore, the classes found by the cluster analyses could further be distinguished based on severity; in general the cluster with high levels of both reactive/proactive aggression showed the highest levels of trait aggression and psychopathic traits. The cluster both medium as well as both high displayed more severe aggressive behavior. This is in accordance with those who revealed that the RPQ could distinguish forensic psychiatric patients from healthy controls based on severity and not on aggression subtype.

With respect to the IPAS results were less conclusive; the clusters both high impulsive/premeditated and mainly impulsive did not differ on the AQ, SDAS and ZAV trait. This suggests that the IPAS clusters cannot be distinguished based on aggression severity solely. The scatterplots also suggested that the IPAS is able to select a subgroup of FPOs only high in impulsive aggression. No subgroup with low levels of aggression were identified. It might be suggest that the IPAS is most applicable to individuals high in impulsive aggressive behavior.

Furthermore, as suggested by Babcock et al. (2014), the questionnaires seemed to be conceptually different. Further examination of the item content leads us to suggest that the RPQ focuses more on actual aggressive behavior (e.g. “Damaged things when mad”) whereas the items of the IPAS are more related to emotions and their regulation (e.g. “I feel I lost control of my temper during the acts”). This notion is supported by the high inter-correlation found between reactive and proactive aggression (RPQ) and the lack of this inter-correlation between the impulsive and premeditated subscales of the IPAS. Because of this high inter-correlation, Raine et al. (2006) suggest to use the residualized scores in order to measure ‘pure’ reactive/proactive aggression independent of the other subtype and general aggressive behavior. No such transformation is needed for the IPAS. The lack of inter-correlation between the subscales of the IPAS might be due to the fact
measure actual aggressive behavior whereas the IPAS seemed to focus on emotion and aggression regulation characteristics. In addition, the RPQ seemed to be appropriate for use in adolescents as well as adults, especially to indicate aggression severity, whereas the impulsive subscale of the IPAS seemed to be reliable only in middle-aged FPOs. Prospective research is needed to replicate the current findings and to elucidate the applicability of both questionnaires in further detail. Enhanced knowledge is needed to make an informed decision about the use of the questionnaires in specific populations.

References


Chapter 7

Aggression Replacement Training among Aggressive Forensic Psychiatric Outpatients

Abstract

Aggression Replacement Training (ART) is widely used to reduce aggression. Results regarding its effectiveness, however, are inconclusive regarding adults and specific populations displaying severe aggression. The current open uncontrolled treatment study aimed at assessing the social skills and anger control modules of the ART to reduce aggression in forensic psychiatric outpatients (FPOs). Furthermore, characteristics associated with treatment outcome and drop-out were examined. The results suggested that aggression changed during the ART. Additionally, higher baseline levels of trait aggression were associated with greater reductions of aggression whereas more cognitive distortions were associated with less reduction. Treatment drop-outs were characterized by higher levels of psychopathic traits, proactive aggression and more weekly substance use. As there was a considerable amount of drop-out, it is important to assess risk for dropping out of treatment and subsequently improve treatment motivation. This might enhance treatment adherence which maybe leads to a more successful reduction of aggression.

Introduction

Disproportionate aggressive behavior can have detrimental effects on victims, offenders, and society (WHO, 2007). Additionally, it is one of the most important reasons for referral to forensic psychiatric institutions. Considering the enormous health, social and economic consequences of aggression, there is a critical need for effective treatments of maladaptive aggressive behavior.

Generally, interventions based on principles of cognitive behavioral therapy (CBT) are the interventions of first choice. A frequently used CBT-based intervention for aggressive behavior is the Aggression Replacement Training (ART, Brännström, Kaunitz, Andershed, South, & Smedslund, 2016). The ART was originally developed for use in children and adolescents and consists of three modules: 1) social skills training which focuses on responding in a pro-social way to difficult situations instead of using aggression, 2) anger control training which learns techniques to exert more control over aggressive thoughts and aggressive impulses, and 3) moral reasoning training where patients learn to recognize certain cognitive distortions relating to aggression by themselves and think in less egocentric way by means of group discussions (Glick & Goldstein, 1987; Goldstein, Glick, & Gibbs, 1998). The modules are given in three weekly sessions during ten weeks. Over the years, the original ART had been modified and applied for other settings, outcomes and populations (Brännström et al., 2016).

Commonly, among either juvenile or adult criminal offenders, positive results of CBT interventions, including the ART have been reported on recidivism, cognitive distortions, antisocial and aggressive behavior (Brännström et al., 2016; Hornsveld, Kraaimaat, Muris, Zwets, & Kanters, 2014; Landenberger & Lipsey, 2005; Lipsey, Chapman, & Landenberger, 2001; Lipsey, Landenberger, & Wilson, 2007). These positive results are also found regarding a more severe population of young forensic psychiatric patients (Hornsveld, van Dam-Baggen, Leenaars, & Jonkers, 2005; Hornsveld et al., 2014; Hornsveld, Nijman, Hollin, & Kraaimaat, 2008; Hornsveld, 2005; Hornsveld, Nijman, & Kraaimaat, 2008). In addition, these studies consider this intervention to be particularly effective in patients with impulsive/reactive aggression, low in psychopathic traits, and with a high disposition to anger at the beginning of treatment. Moreover, patients who did not complete ART exhibited more chronically antisocial behavior, higher levels of psychopathy and were at higher risk of violent recidivism (Hornsveld et al., 2014; Hornsveld et al., 2008). This is in agreement with studies showing that negative effects of ART on adult recidivism were solely found among individuals who did not complete the intervention (Brännström et al., 2016).
Still, results regarding the effectiveness of the ART might be considered as inconclusive. A recent systematic review documented that at an individual study level ART indeed had positive effects on recidivism and anger control, social skills, and moral reasoning in adolescents as well as in adults (Brännström et al., 2016). However, overall the quality of the reviewed studies was found to be insufficient to conclusively claim that the ART is effective. Major concerns are that the target groups have not been described sufficiently, description of missing or incomplete data is inadequate, and author bias might have been occurred as studies have been conducted by researchers associated with the development of the ART. Considering the wide spread use of interventions like the ART, more research is needed to explore its effectiveness in specific and clearly described populations. Over the years, the original ART had been modified and applied for other settings, outcomes and populations (Brännström et al., 2016).

Previous studies regarding the effectiveness of the ART have been mainly focused on child and adolescent samples. However, ART is also often administered to adults to reduce aggression and promote pro-social behavior. Studies conducted among adult populations, moreover, consisted of heterogeneous samples (Brännström et al., 2016) including violent offenders, individuals convicted for crimes like robbery and even offenders with a history of psychosis. Results from these kinds of studies do not provide clear cut evidence for the effectiveness of the ART on, specifically, aggressive behavior in adults. Furthermore, it is of great importance to elucidate which characteristics are associated with treatment response and to investigate to which subgroup of individuals this treatment is suitable. This knowledge would enable clinical practice to develop personalized treatment which may enhance treatment adherence and improve the effectiveness, which is of great importance as drop-out rates among outpatients receiving aggression treatment are high (Hornsved et al., 2008). In the long run, this might result in a more successful reduction of aggressive behavior.

Several characteristics are thought to be associated with a stronger reduction of aggression to ART such as reactive aggression, a high disposition to anger and low levels of psychopathic traits (Hornsved et al., 2004; Hornsved et al., 2014; Hornsved et al., 2008; Hornsved, 2005; Hornsved et al., 2008). Another feature which seems to be important to consider is the impact of distorted cognitions. Cognitive distortions are defined as inaccurate attitudes, thought or beliefs regarding own or others behavior and are associated with externalizing tendencies, such as aggression (Barriga & Gibbs, 1996; Barriga, Landau, Stinson, Liu, & Gibbs, 2000). A recent meta-analysis suggested that successful interventions on cognitive distortions could result in a decrease in externalizing problem behavior (Helmond, Overbeek, Brugman, & Gibbs, 2014). High levels of cognitive distortions, when untreated, might then also be related to a less successful reduction of externalizing problems, such as aggressive behavior. Additionally, substance use is closely related to antisocial and offending behavior and occurs frequently in forensic psychiatric patients (Doran, Lucczk, Bekman, Koutsenok, & Brown, 2012; Ruiz, Douglas, Edens, Nikolova, & Lilienfeld, 2012; van der Kraan et al., 2014). It is suggested that when substance problems are not the primary diagnosis, it still is important to increase insight in substance use as risk factor for the recurrence of criminal or antisocial behavior (van der Kraan et al., 2014). Furthermore, it was thought that this increase in insight is associated with treatment motivation and therefore also with treatment effectiveness. High levels of substance use in combination with limited insight in the consequences and associations with current aggressive behavior might then also be negatively related to treatment response.

Taken together, studies regarding the ART do not provide clear cut evidence for a specific population of adults displaying clinical levels of aggressive behavior. Furthermore, it is unknown whether reactive and trait aggression, psychopathic traits, cognitive distortions and substance use are associated with the response or drop-out of the ART in adults. The current open uncontrolled trial study, therefore, was designed 1) to assess if aggressive behavior reduced during ART in a specific population of adult forensic psychiatric outpatients (FPOs) with aggression regulation problems; 2) to examine whether trait and type of aggressive behavior, cognitive distortions, psychopathic traits and substance use at baseline moderated the change in aggression during the ART; and 3) to investigate whether treatment drop-outs differed from treatment completers in aforementioned characteristics.

**Methods**

**Participants**

In the period from January 1, 2012, to June 15, 2015, 963 forensic psychiatric outpatients (FPOs) were referred to “Kairos”, the outpatient unit of Forensic Psychiatric Clinic the Pomeestichting in Nijmegen, The Netherlands because of aggression regulation problems. Inclusion to the study required to meet each of the following criteria: 1) a diagnosis of an antisocial, borderline and/or narcissistic personality disorder, and/or the intermittent explosive disorder (IED), and 2) a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). In addition, FPOs were excluded if there was a current major depression, current severe addiction or lifetime bipolar disorder or psychosis. In the current study, 233 male and female FPOs were eligible and willing to participate. An overview of reasons for exclusion is provided in Table 1.
Of the 213 FPOs, 44 were excluded because of: no show at the screening appointment (N = 22), current major depression (N = 2), no current aggressive behavior (N = 10), not willing to participate anymore (N = 4), or no show at the base-line assessment start of treatment (N = 6). Eventually, 169 FPOs participated in the present study of which 125 performed the half-way measurement and 115 performed the end of treatment measurement as well. Of the 169 participating FPOs, 58 dropped-out of the current study because of: no show during intervention (N = 47), death (N = 2), reference to other type of treatment (for addiction or for autism; N = 7), not willing to participate anymore (N = 2). Unfortunately, no follow-up information regarding this drop-out group is available. Furthermore, admission to Kairos occurs on either obligatory (e.g. when sentenced by a judge) or voluntary basis (based on reference by general practitioner). In the current study, 124 patients were referred voluntarily and 45 obligatory.

Demographic information is provided in Table 2. All participants signed a consent form after receiving information about the study and obtained a monetary compensation. The current study was approved by the regional Ethics Committee, CMO region Arnhem-Nijmegen, The Netherlands.

**Measures**

The Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990) is an observer-scale that measures the severity of actual aggressive behavior. The score on the SDAS was used as primary outcome measure. It consists of nine items measuring outward aggression and two items measuring inward aggression. Items have to be scored on a 4-point Likert scale with 0 = not present and 4 = severely to extremely present as extremes. The SDAS has adequate observer reliability (Wistedt et al., 1990). In the current study, due to lack of observers, the SDAS was used as self-report. Participants had to rate their aggressive behavior over a period of three months. The SDAS was administered at baseline, half-way and end-of-treatment measurement. In the current study, the SDAS as self-report demonstrated acceptable test-retest stability: intraclass correlation coefficient (ICC) baseline – half-way measurement = .686, p < .01; half-way – end of treatment measurement = .763, p < .01; baseline – end of treatment measurement = .653, p < .01 and acceptable internal consistency: Cronbach’s Alpha baseline = .76, half-way measurement = .82, end of treatment measurement = .82.
ART Among Forensic Patients

The Clinical Global Impression Scale (CGI; Guy, 1976) is widely used to assess severity of symptoms and to measure improvement according to clinicians. Both subscales are rated by the clinician on a 7-point Likert scale with 1 = normal, not ill and 7 = among the most extremely ill patients as extremes regarding severity and 1 = very much improved and 7 = very much worse as extremes with respect to improvement. The CGI was filled out at baseline, half-way and end-of-treatment measurement.

The Reactive Proactive Questionnaire (RPO; Cima, Raine, Meesters, & Popma, 2013; Raine et al., 2006) is a 23-item self-report questionnaire to measure reactive and proactive aggression at baseline and end-of-treatment measurement. The reactive subscale consists of 11 items whereas the proactive subscale consists of 12 items. The items are rated 0 (never), 1 (sometimes) or 2 (often). The Dutch translation has good internal consistency and adequate convergent, criterion and construct validity (Cima et al., 2013). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha = .91 for baseline measurement and .93 for end of treatment measurement). The RPO was administered at baseline and end-of-treatment.

The Aggression Questionnaire (AQ; Buss & Perry, 1992) is a self-report questionnaire to assess overall trait level of aggression. It consists of 29 items which are divided into four subscales: physical aggression, verbal aggression, anger and hostility. The items are scored on a 5-point Likert scale (1=extremely unlike me to 5= extremely like me). The Dutch translation has adequate psychometric properties (Morren & Meesters, 2002). In the present study the internal consistency has also proven to be good (Cronbach’s Alpha = .91 for baseline measurement and .93 for end of treatment measurement). The AQ was administered at baseline and end-of-treatment measurement.

The How I Think questionnaire (HIT; Barriga & Gibbs, 1996) is a 54-item self-report questionnaire to assess self-serving cognitive distortions at baseline and end-of-treatment measurement. The items are divided into four cognitive distortion subscales (self-centered, blaming others, minimizing/labeling, assuming the worst) and four behavioral referent categories (physical aggression, opposition-defiance, lying, stealing). Items have to be answered on a 6-point Likert scale. The Dutch translation has proven reliability and validity (Nas, Brugman, & Koops, 2008) in the current study the internal consistency has also proven to be good (Cronbach’s Alpha = .93 for baseline measurement and .94 for end of treatment measurement). The HIT was administered at baseline and end-of-treatment measurement.

The Self-Report Psychopathy Short-Form (SRP-SF; Paulhus, Neumann, & Hare, 2015) is a self-report measure of adult psychopathic features. The SRP-SF consists of 29 statements which are divided into four subscales: Interpersonal manipulation, callous affect, erratic life styles, and criminal tendencies. Participants have to rate the extent to which they agree with these statements on a 5-point Likert scale (1= disagree strongly, 5 = agree strongly). The Dutch version of the SRP-SF has good internal-consistency and test-retest reliability (Gordts, Uzieblo, Neumann, Van den Bussche, & Rossi, 2015). In the present study the internal consistency has also proven to be good (Cronbach’s Alpha = .88). The SRP-SF was only administered at baseline measurement.

Intervention

All FPOs were referred to the ART. Besides ART for general aggression and violence, ART was also offered for perpetrators of intimate partner violence. This version of the ART is identical to the regular ART except that the partners of the FPOs were involved during this intervention (N = 58). Both the regular ART as well as the ART for domestic violence perpetrators consisted, as offered by “Kairos”, of two of the three original modules: 1) social skills training and 2) anger control training. Both interventions occurred either in groups (N = 116) or individually (N= 46) and consisted of twelve 90-minutes weekly sessions. The first 10 weeks consisted of the social skills and anger control training. Week 11 consisted of a session to integrate all that was learned in the previous weeks. Finally, week 12 consisted of an evaluation session. Indication for ART was determined by a multidisciplinary team. The ART therapists were all formerly trained in applying the ART and, in addition, made use of a detailed intervention manual and participated in intervision.

Procedure

Clinicians at “Kairos” asked FPOs who were referred to ART (group or individual), whether they agreed to be contacted about the study. When they agreed, FPOs were contacted by the researcher. All FPOs, received treatment as indicated whether they participated in the study or not.

After receiving information about the nature of the study, a consent form was signed. The FPOs were screened by trained clinicians with the Structured Clinical Interview for DSM-IV axis II personality disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000), the Research Criteria set for Intermittent Explosive Disorder (IED-IR; Coccaro, Kavoussi, Berman, & Lish, 1998) and the MINI International Neuropsychiatric Interview (MINI; Sheehan et al., 1998; Van Vliet & De Beurs, 2007) regarding the aforementioned in- and exclusion criteria.
Once FPOs were suitable for participation they proceeded with the baseline measurement which was completed before the start of their treatment. Halfway, after 6 weeks, the level of aggressive behavior was determined by use of the SDAS. An end of treatment measurement took place after 12 weeks. The FPOs were instructed not to use alcohol or drugs 24 hours prior to any of the assessments. The CGI was administered by clinicians at baseline, half-way and end of treatment.

Statistical analysis
First, a MANOVA was conducted in order to investigate whether there were differences on the SDAS, CGI, RPQ, AQ, HIT, psychopathy and measures of substance use, between FPOs who received ART as usual or ART for domestic violence perpetrators and FPOs who received group or individual ART. Subsequently, it was examined whether aggressive behavior changed over time by using a linear mixed model (SPSS, version 24). One advantage of this analysis is that it is possible to include individuals with incomplete data, without imputing data (Heck, Thomas, & Tabata, 2013). As the aggression assessment half-way and end of treatment were not completed for all participants, this method was favored. The basic model was a repeated-measures design with aggressive behavior as measured with the SDAS as dependent variable and Time of measurement (baseline, half-way, end of treatment) as within-subjects factor. Repeated covariance type was set at unstructured. Subsequently, a similar linear mixed model was conducted now with the CGI improvement as dependent variable and Time of measurement (baseline, half-way, end of treatment) as within-subjects factor. Repeated covariance type was set at diagonal. With respect to Time, the slope was set as a fixed effect and the intercept as a random effect. This random effect was defined in order to assess variation in the dependent variable because variation among individuals, regarding change in aggression over time, was assumed (Bolker et al., 2009; West, Welch, & Galecki, 2014). The covariance type for the random effects was set at unstructured. Subsequently, a similar linear mixed model was conducted now with the CGI improvement as dependent variable and Time of measurement (baseline, half-way, end of treatment) as within-subjects factor, to examine whether aggressive behavior decreased during treatment according to clinicians.

Next, it was investigated whether baseline characteristics measured using the AQ, HIT, RPQ, SRP-SF and substance use moderated the effect of time by adding main effects of the AQ, HIT, RPQ, SRP-SF and weekly alcohol and cannabis use and two-way interactions of AQ, HIT, RPQ, SRP-SF and substance use with Time to the basic model. The basic model with the SDAS as dependent variable was used as the main outcome measure of the current study. To be able to interpret the results the variables were centered; the sample mean was subtracted from the individuals mean.

Finally, to investigate the underlying differences between treatment drop-outs and treatment completers, a MANOVA regarding baseline measurements was conducted.

| Table 3. Descriptives (Mean, SD) of the completers versus the drop-outs and total sample |
|-----------------------------------------------|------------------|------------------|
|                                      | Completers (N = 111) | Drop-outs (N = 58) | Total sample (N = 169) |
|-----------------------------------------------|------------------|------------------|
| CGI baseline                                  | M = 3.67 (SD = .56) | M = 3.84 (SD = .44) | M = 3.72 (SD = .53) |
| CGI half-way                                  | M = 2.99 (SD = .66) | -                | M = 2.99 (SD = .66) |
| CGI end of treatment                          | M = 2.83 (SD = .87) | -                | M = 2.83 (SD = .87) |
| SDAS baseline                                 | M = 15.16 (SD = 6.19) | M = 15.14 (SD = 7.09) | M = 15.14 (SD = 6.49) |
| SDAS half-way                                 | M = 16.79 (SD = 6.67) | -                | M = 16.79 (SD = 6.67) |
| SDAS end of treatment                         | M = 8.48 (SD = 6.35) | -                | M = 8.48 (SD = 6.35) |
| AQ                                            | M = 91.99 (SD = 18.41) | M = 95.00 (SD = 19.21) | M = 93.02 (SD = 18.69) |
| RPQ proactive                                 | M = 5.31 (SD = 2.74) | M = 5.31 (SD = 2.53) | M = 5.31 (SD = 2.66) |
| HIT                                           | M = 2.41 (SD = .73) | M = 2.56 (SD = .81) | M = 2.46 (SD = .74) |
| Alcohol *                                     | M = 6.05 (SD = 11.53) | M = 11.67 (SD = 20.35) | M = 7.99 (SD = 15.34) |
| Cannabis *                                    | M = 2.53 (SD = 7.61) | M = 7.71 (SD = 20.28) | M = 4.31 (SD = 13.54) |
| SRP-SF *                                      | M = 66.75 (SD = 16.56) | M = 73.62 (SD = 19.95) | M = 69.15 (SD = 17.71) |

Note: alcohol and cannabis use is defined as mean units/joint per week.
The mean total score on the improvement subscale of the Clinical Global Impression Scale (CGI), the Social Dysfunction and Aggression Scale (SDAS), the Aggression Questionnaire (AQ), the reactive and proactive aggression subscale of the Reactive Proactive Questionnaire (RPQ), the How I Think questionnaire (HIT) and the Self-Report Psychopathy short form (SRP-SF) are reported. * Groups significantly differ from each other at least p<.05.

Results
Table 3 displays the means on the SDAS, CGI, AQ, RPQ, HIT and SRP-SF, and the weekly alcohol and cannabis use. Means are presented for the total sample as well as separately for the treatment drop-outs and completers.

Differences among FPOs
A MANOVA was conducted to investigate whether FPOs who received regular ART vs. ART for domestic violence perpetrators and FPOs who received group versus individual ART differed regarding type, trait and severity of aggression, substance use, cognitive distortions and psychopathy. Bonferroni correction was used to control for multiple comparisons. No significant multivariate effects of ART vs. ART for domestic violence and group vs. individual treatment emerged, Wilks’ Lambda = .794, F(13, 68) = 1.383, p = .191, eta² = .209; Wilks’ Lambda = .890, F(13, 68) = .645, p = .808, eta² = .110, respectively. Therefore, in subsequent analyses the FPOs were considered as one sample.
Effect on aggressive behavior

The analyses of both basic models “Time, SDAS” as well as “Time, CGI” revealed a significant main effect of Time, indicating that aggressive behavior significantly decreased during treatment. A graphic representation of the change in aggressive behavior (SDAS) is displayed in Figure 1. As an effect size is not provided by linear mixed models, Cohen’s D was calculated by dividing the mean difference between pre- and post-SDAS scores by the pooled standard deviation: $15.19 - 8.48 / \sqrt{(6.14^2 + 6.25^2)/2} = 1.08$.

The basic model (Time, SDAS) was extended by adding AQ, HIT, RPO reactive, RPO proactive, SRP-SF, weekly alcohol and weekly cannabis use as possible predictor variables. Significant main effects of AQ, HIT, RPO and SRP-SF emerged, suggesting that these characteristics were associated with differences in aggressive behavior. In the subsequent model, 2-way interactions were included to examine which characteristics might explain variability in aggression reduction during treatment. The analysis of this model revealed a significant main effect of Time, AQ, RPO reactive, RPO proactive and significant

*The change in aggressive behavior was similar in all subgroups: regular ART, ART for domestic violence perpetrators, group and individual treatment, male and female, voluntary and obligatory.
interactions of Time × AQ and a marginal significant interaction of Time × HIT (see Table 4). In the final model, non-significant interactions were removed. The results suggest that the disposition to act aggressively (AQ) and cognitive distortions (HIT), measured at baseline, were associated with the course of treatment; i.e. high AQ baseline score leads to a more rapid decrease of aggression, whereas high HIT baseline scores lead to a less rapid reduction of aggression. A graphic representation of both significant interaction effects are displayed in Figure 2.1 and 2.2. For this graph, predicted values were calculated by using the regression equation of the final model. For Figure 2.2, percentile scores of the AQ and mean scores of all other predictors were used. For Figure 2.2, percentile scores of the HIT and mean scores of all other predictors were used.

**Drop-out**

Means and SDs for baseline measures of treatment drop-outs and completers are presented in Table 3. Bonferroni correction was used to control for multiple comparisons. A significant multivariate effect of group was found, Wilks' Lambda = .893, $F(7, 155) = 2.66$, $p = .013$, $\eta^2 = .107$. Separate univariate ANOVAs revealed that drop-outs, compared to completers used more weekly alcohol and cannabis, displayed more proactive aggression and more psychopathic traits $F(1, 161) = 5.80$, $p = .027$, $\eta^2 = .035$; $F(1, 161) = 5.35$, $p = .022$, $\eta^2 = .032$; $F(1, 161) = 3.91$, $p = .050$, $\eta^2 = .024$; and $F(1, 161) = 5.29$, $p = .023$, $\eta^2 = .032$ respectively. No significant group differences were found on AQ, HIT and RPQ reactive $F(1, 161) = 2.15$, $p = .144$, $\eta^2 = .013$ respectively.

**Discussion**

The present study investigated the change in aggressive behavior during an intervention based on the anger control and social skills modules of the ART among FPOs with severe aggressive behavior. It was found that aggressive behavior decreased during the intervention according to clinicians and the self-report of FPOs. The current study complements previous findings by revealing that the social skills and anger control modules of the ART reduce aggression in a specific population of adult FPOs displaying clinical levels of aggression. Moreover, in agreement with previous studies (Hornsveld, 2005), the present results showed that a larger tendency to aggressive behavior at baseline measurement was associated with a more rapid decrease in aggression over the course of treatment. Cognitive distortions, on the other hand, were found to be negatively related to treatment outcome; more cognitive distortions were associated with a less rapid reduction of aggressive behavior. With regard to psychopathic traits, substance
use and aggression subtype, no interactions were found with treatment outcome. This is in contrast with previous studies showing that the ART was in particular effective in individuals displaying reactive aggression (Hornsved et al., 2004; Hornsved et al., 2008). A possible explanation for this discrepancy is that the patients in the present study were all diagnosed with aggression regulation disorders and mainly displayed reactive aggressive behavior. It is possible that there was too little variation in aggression subtype and that, therefore, the current study mainly focused on FPOs with reactive aggressive behavior.

Regarding treatment drop-out, higher levels of proactive aggression and psychopathic traits emerged to be associated with drop-out, which is in agreement with previous studies (Hornsved et al., 2014). In addition, more weekly alcohol and cannabis use were reported by FPOs who dropped out of treatment. Problems regarding substance use occur frequently in FPOs (Ruiz et al., 2012; van der Kraan et al., 2014). In the present study, FPOs with substance abuse or dependency were excluded from participation. Previously, it was suggested that substance use may function as risk factor for recidivism (van der Kraan et al., 2014). The current results suggest that it is important to take into account the amount of substance use as it also may be a reason to drop out. Furthermore, as suggested by van der Kraan et al. (2014) it might be necessary to increase insight in substance use as this might be related to treatment adherence and/or motivation.

The current findings may have implications with respect to forensic mental health settings. The disposition to act aggressively, cognitive distortions, substance abuse and psychopathy were found to be associated with treatment response and drop-out. This knowledge can be used to make an informed decision whether ART is suitable for a specific individual patient and to develop personalized treatment. For instance, it may be important to determine the magnitude of cognitive distortions before the start of treatment. This may be of particular importance regarding group interventions: More focus on altering these distortions might be necessary to reduce aggression equally rapidly as patients with less cognitive distortions. It also might be of interest to examine whether type of cognitive distortions is associated with treatment outcome. In the end, this would result in interventions that are more concentrated on altering these specific distortions and, therefore, maybe more successful in reducing aggression. Moreover, the current results might advocate the addition of the moral reasoning training module, as this module focuses on cognitive distortions. Future research needs to elucidate whether adding this module is sufficient in reducing cognitive distortions and results in a more successful decrease of aggression in a population of individuals with severe aggression.

Additionally, when there is a high risk of drop-out, special attention may be needed on treatment motivation. Treatment motivation is considered to be a crucial factor related to treatment outcome and is associated with treatment-related behavior such as compliance, engagement and adherence (Drieschner, Lammers, & van der Staak, 2004). Motivational interviewing (MI) can be used to increase treatment motivation. MI is a directive, client-centered, method for improving intrinsic motivation to change through exploring and resolving ambivalence (Miller & Rollnick, 2002). Previous studies showed that MI improved treatment adherence and the motivation to change in criminal offenders and individuals with substance use disorders (Crane & Eckhardt, 2013; Doran et al., 2012; Dunn, Ieroo, & Rivara, 2001; Feldstein & Ginsburg, 2006; McMurran, 2009). Moreover, it would be highly interesting to explore whether MI could be a regular module in ART.

The present study and results have a number of limitations which merit further comment. First, the ART examined in the current study only consisted of two modules instead of three. Therefore, the current results are not generalizable to the use of the entire ART. Subsequently, as this was an open uncontrolled trial study and lacked a comparison or control group the results have to interpret with care. Third, except for the CGI, all measurements consisted of self-report. It is questionable whether a population of FPOs is fully able to reflect on their own behavior and whether they are willing to answer genuinely. In addition, no follow-up measurement was included. This would enable one to determine the long-term effects of the ART and to distinguish whether specific individuals have a higher tendency to recidivate. Fourth, solely a few women participated, the current findings may, therefore, not be generalizable to a female population with aggression regulation problems. Future research is needed to elucidate the effectiveness over a proper control condition and also more research is needed on the working mechanisms of the ART in forensic psychiatric clinical practice.

Notwithstanding the limitations and nature (open uncontrolled trial) of the current study, the present results suggest that aggressive behavior changed during the social skills and anger control modules of the ART in adult populations displaying severe levels of aggression. Subsequently, is seems to be of importance to examine patients before the start of their treatment regarding cognitive distortions, psychopathic traits and substance use. Using this knowledge enables clinical practice to make an indication of the chance of drop-out and to target an intervention more specifically towards the individual patient which, in the end probably in combination with MI, will enhance treatment adherence and reduce aggressive behavior more successfully.
References


Chapter 8

Associations between Neurocognitive Characteristics, Treatment Outcome and Drop-out among Aggressive Forensic Psychiatric Outpatients

Smeijers, D., Bulten, E., Buitelaar, J., & Verkes, R.J. Associations between Neurocognitive Characteristics, Treatment Outcome and Drop-out among Aggressive Forensic Psychiatric Outpatient. (Revision submitted).
Abstract

Aggression Replacement Training (ART) is widely used to reduce aggression and is considered to be effective although there are also inconsistent results. Studies investigating the effectiveness of ART do not focus on neurocognitive characteristics. Focusing on these aspects would result in enhanced understanding of underlying mechanisms of ART. The current open uncontrolled treatment study assessed whether neurocognitive characteristics were associated with change in aggression during the social skills and anger control modules of ART among forensic psychiatric outpatients (FPOs). Furthermore, differences between treatment drop-outs and completers and change in these characteristics during ART were examined. A reduction of trait aggression, cognitive distortions and social anxiety was observed. Neurocognitive characteristics were not associated with change in aggression, could not distinguish treatment completers from drop-outs and did not change after ART. It is suggested that new paradigms should be developed which takes into account the social context in which these impairments appear.

Introduction

Disproportionate aggressive behavior is one of the most important reasons for referral to forensic psychiatric institutions. Aggression Replacement Training (ART; Glick & Goldstein, 1987; Goldstein, Glick, & Gibbs, 1998) is frequently used in children and adolescents as well as in adults to reduce aggression (Brännström, Kaunitz, Andershed, South, & Smedslund, 2016). The ART consists of three modules: 1) social skills training; which focus on responding in a pro-social way to difficult situations instead of using aggression, 2) anger control training; which learns techniques to have more control over aggressive thoughts and aggressive impulses, and 3) moral reasoning training; where patients learn to recognize certain cognitive distortions relating to aggression by themselves and think in less egocentric way by means of group discussions. The modules are given in three weekly sessions during ten weeks.

In general, ART is considered to be effective in decreasing aggressive behavior among forensic psychiatric patients (FPOs), even though there are also inconsistent results (Brännström et al., 2016). Furthermore, studies indicate that a high disposition to act aggressively before treatment is positively associated with treatment response (Hornsved, van Dam-Baggen, Leenaars, & Jonkers, 2004; Hornsveld, Kraaimaat, Muris, Zwets, & Kanters, 2014; Hornsveld, Nijman, Hollin, & Kraaimaat, 2008; Hornsveld, 2005; Hornsveld, Nijman, & Kraaimaat, 2008; Smeijers, Bulten, et al., submitted) whereas presence of cognitive distortions is thought to be related to a less rapid reduction of aggression (Smeijers, Bulten, et al., submitted). In addition, patients who dropped out of ART are characterized by more weekly alcohol and cannabis use, higher levels of psychopathic traits and proactive aggression (Hornsved et al., 2014; Hornsveld et al., 2008; Smeijers, Bulten, et al., submitted).

Studies investigating the effectiveness of the ART, however, often focus on behavioral and/or personality characteristics. However, neurocognitive characteristics are also found to be associated with aggressive behavior. As suggested by the Social Information Processing model (SIP model), individuals with severe aggressive behavior have abnormal response repertoires in social situations due to modified information processing (Crick & Dodge, 1996). Information processing might be altered because of cognitive biases. In specific, two forms of cognitive biases are frequently associated with aggressive behavior: attentional biases and hostile attribution/interpretation biases. An attentional bias refers to an a-priori tendency to focus selectively on threatening information and is often measured by use of the Emotional Stroop Task. An attentional bias towards aggressive or violence related words has been associated with higher levels of aggressive behavior in...
student populations as well as offenders and forensic psychiatric patients (e.g. Brugman et al., 2014; Chan, Raine, & Lee, 2010; Domens, Mense, Vohs, & Habermeyer, 2013; Smith & Waterman, 2003, 2004).

Hostile attribution/interpretation biases, on the other hand, refer to attributing hostile intent to others actions and to interpret emotional facial expressions as hostile. Studies regarding these specific biases revealed that hostility biases are associated with higher levels of aggressive behavior in children as well as adults and in student populations as well as offenders and forensic psychiatric patients (e.g. Chen, Coccaro, & Jacobson, 2012; Dodge, 2006; Schonenberg & Jusyte, 2014; Smeijers, Rinck, Bulten, van den Heuvel, & Verkes, 2017). Both biases could be important causes as well as maintaining factors of aggressive behavior. Additionally, possibly related to these biases is social approach and avoidance behavior. For instance, it is thought that angry facial expressions operate as a signal of threat by transferring the expresser’s aggression (Blair, 2003). In general, this results in avoidance behavior as one wants to avoid potential danger. However, psychopaths appear to lack this automatic avoidance tendency, as measured by use of the Approach Avoidance Task (von Borries et al., 2012). Furthermore, it is thought that anger is associated with approach motivation (Carver & Harmon-Jones, 2009). It is possible that one of the aforementioned biases, and aggressive behavior in itself, are related to this social approach and avoidance behavior.

Another neurocognitive characteristic often associated with aggressive and antisocial behavior is impulsivity which is described as the inability to withhold a response or thought, preference for immediate reward, acting without forethought, sensation-seeking and a tendency to engage in risky behavior (for review see Bari & Robbins, 2013). Computerized tasks often used to measure impulsivity and response inhibition are the Go/No Go paradigm, Stop Signal Task and the Continuous Performance Task. The latter is also used to measure sustained attention. Studies using these tasks have shown that higher levels of aggressive behavior is associated with impulsivity and impaired response inhibition, expressed in shorter reaction times or more errors, in student samples as well as in forensic psychiatric patients (e.g. Harmon-Jones, Barratt, & Wigg, 1997; Ogilvie, Stewart, Chan, & Shum, 2011; Pawliczek et al., 2013; Tonnaer, Cima, & Arntz, 2016; Vigil-Colet & Codomiu-Raga, 2004).

To date, no previous studies investigated neurocognitive characteristics in relation to aggression treatment. It is of great importance to examine which neurocognitive characteristics are associated with treatment outcome and to further elucidate to which subgroup of individuals this treatment is suitable. This can result in better interference related to these deficits in order to develop personalized treatment. In the long run, this might result in enhanced treatment adherence and eventually a more successful reduction of aggressive behavior.

The current open uncontrolled treatment study was in continuation of Smeijers, Bulten, et al. (submitted) and was now aimed at 1) examining whether neurocognitive characteristics at baseline were associated with the change in aggression during ART among forensic psychiatric outpatients (FPOs) with severe aggressive behavior; 2) to explore whether treatment drop-outs differed from treatment completers in these underlying neurocognitive characteristics; and 3) to examine which characteristics, other than aggression, changed during treatment.

Method

Participants

In the period from January 1, 2012, to June 15, 2015, 963 forensic psychiatric outpatients (FPOs) were referred to “Kairos”, the outpatient unit of Forensic Psychiatric Clinic the Pomestichting in Nijmegen, The Netherlands because of aggression regulation problems. Inclusion to the study required to meet each of the following criteria: 1) a diagnosis of an antisocial, borderline and/or narcissistic personality disorder, and/or the intermittent explosive disorder (IED), and 2) a total score of five points or higher on the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). Additionally, FPOs were excluded if there was a current severe addiction, current major depression, or lifetime bipolar disorder or psychosis. In the current study, 223 male and female FPOs were eligible and willing to participate. An overview of reasons for exclusion is provided in Table 1.

Of the 223 FPOs, 44 were excluded because of: no show at the screening appointment (N = 22), no show at the base-line assessment start of treatment (N = 6), not willing to participate anymore (N = 4), no current aggressive behavior (N = 10) or current major depression (N = 2). Eventually, 169 FPOs participated in the present study of which 125 performed the half-way measurement and 115 performed the end of treatment measurement as well. Of the 169 participating FPOs, 58 dropped-out of the current study because of: no show during intervention (N = 47), not willing to participate anymore (N = 2), reference to other type of treatment (for addiction or for autism; N = 7) and death (N = 2). Unfortunately, no follow-up information regarding this drop-out group is available. Furthermore, admission to Kairos occurs on either obligatory (e.g. when sentenced by a judge) or voluntary basis (based on reference by general practitioner). In the current study, 124 patients were
referred voluntarily and 45 obligatory. Demographic information is provided in Table 2. All participants signed a consent form after receiving information about the study and obtained a monetary compensation. The current study was approved by the regional Ethics Committee, CMO region Arnhem-Nijmegen, The Netherlands.

### Materials

#### Questionnaires

The Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990) is an observer-scale that measures the severity of actual aggressive behavior. It consists of nine items measuring outward aggression and two items measuring inward aggression. Items have to be scored on a 4-point Likert scale with 0 = not present and 4 = severely to extremely present as extremes. The SDAS has adequate observer reliability (Wistedt et al., 1990). In the current study, due to lack of observers, the SDAS was used as self-report. Participants had to rate their aggressive behavior over a period of three months. The SDAS as self-report demonstrated acceptable test-retest stability: intraclass correlation coefficient (ICC) baseline – halfway measurement = .686, \( p < .01 \); halfway – end of treatment measurement = .763, \( p < .01 \); baseline – end of treatment measurement = .651, \( p < .01 \) and acceptable internal consistency: Cronbach's Alpha baseline = .76, halfway measurement = .82, end of treatment measurement = .82. (Smeijers, Bulten, et al., Submitted).

The Aggression Questionnaire (AQ; Buss & Perry, 1992) is a self-report questionnaire to assess an overall trait level of aggression. It consists of 29 items which are divided into four subscales: physical aggression, verbal aggression, anger and hostility. The items are scored on a 5-point Likert scale (1=extremely unlike me to 5= extremely like me). The Dutch translation has adequate psychometric properties (Morren & Meesters, 2002). In the present study the internal consistency has also proven to be good (Cronbach's Alpha = .91 for baseline measurement and .93 for end of treatment measurement). The AQ was administered at baseline and at end-of-treatment measurement.

The How I Think questionnaire (HIT; Barriga & Gibbs, 1996) is a 54-item self-report questionnaire to assess self-serving cognitive distortions at baseline and end-of-treatment measurement. The items are divided into four cognitive distortion subscales (self-centered, blaming others, minimizing/labeling, assuming the worst) and four behavioral referent categories (physical aggression, opposition-defiance, lying, stealing). Items have to be answered on a 6-point Likert scale. The Dutch translation has proven reliability and validity (Nas, Brugman, & Koops, 2008). In the current study the internal consistency has also proven to be good (Cronbach’s Alpha = .91 for baseline measurement and .93 for end of treatment measurement). The HIT was administered at baseline and at end-of-treatment measurement.

<table>
<thead>
<tr>
<th>Table 1. Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reason</strong></td>
</tr>
<tr>
<td>Negative decision by therapist due to severity of psychopathology</td>
</tr>
<tr>
<td>Dropout after intake/not suitable for treatment</td>
</tr>
<tr>
<td>Refused to participate</td>
</tr>
</tbody>
</table>

| Total | 750 |

<table>
<thead>
<tr>
<th>Table 2. Demographic information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean / N</strong></td>
</tr>
<tr>
<td>Age ( M = 35.79 (SD = 10.94) )</td>
</tr>
<tr>
<td>Male ( N = 10 )</td>
</tr>
<tr>
<td>Female ( N = 159 )</td>
</tr>
<tr>
<td>Alcohol use, unit/week ( M = 7.99 (SD = 15.34) )</td>
</tr>
<tr>
<td>Cannabis use, joint/week ( M = 9.12 (SD = 11.19) )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Diagnosis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Antisocial personality disorder ( N = 68 )</td>
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<tr>
<td>Borderline personality disorder ( N = 35 )</td>
</tr>
<tr>
<td>Narcissistic personality disorder ( N = 6 )</td>
</tr>
<tr>
<td>Intermittent explosive disorder ( N = 145 )</td>
</tr>
<tr>
<td>ADHD ( N = 46 )</td>
</tr>
<tr>
<td>History of depressive disorder ( N = 110 )</td>
</tr>
</tbody>
</table>

*as measured by using the Dutch Adult Reading Test (Schmand, Bakker, Saan, & Louman, 1991).
The Inventory of Interpersonal Situations (IIS; Dam-Baggen & Kraaimaat, 2000) is a self-report measure that assesses two aspects of social anxiety; discomfort experiences in interpersonal situations and frequency of assertive social responses in those situations. The IIS contains two scales with 35 items each. The items are scored on a 5-point Likert scale (1 = not at all to 5 = a lot). The Dutch version of the IIS has demonstrated adequate validity and reliability (Dam-Baggen & Kraaimaat, 2000). In the current study, only the subscale regarding discomfort experiences/social anxiety was of interest. In the current study the internal consistency of this subscale has also proven to be good (Cronbach’s Alpha = .96 for baseline measurement and .96 for end of treatment measurement). The IIS was administered at baseline and end-of-treatment measurement.

Paradigms

The Point Subtraction Aggression Paradigm (PSAP) measures aggression in response to provocation. The goal of the task was to earn as much money as possible. Participants were instructed to play an online game against a confederate. Two response options were available: 1) pressing the “A” button 40 times, the participant earns two dollars, 2) pressing the “B” button 10 times, two dollars will be deducted from the participant fictitious opponent. The fictitious opponent also subtracts points from the participant on a predetermined basis. The number of times the point subtraction button is pressed is the dependent measure of aggression. The PSAP has proven psychometric properties (Cherek, Tcheremissine, Lane, & Nelson, 2006). The PSAP was administered at baseline and end-of-treatment measurement.

The Hostile Interpretation Bias Task (HIBT; Smeyers, Rinck, Bulten, van den Heuvel, & Verkes, 2007) was used to assess a HIB at baseline and end-of-treatment measurement. Photos of faces with emotional affect (angry, fear, disgust, happy) of four male and four female models were selected from the Radboud Faces Database (Langner et al., 2010). Each affective picture was morphed (using WinMorph 3.01) five times with the neutral image of the same individual, creating 20%, 40%, 60%, 80% and 100% emotion intensity, respectively. The neutral expression was in all models displayed with mouth closed whereas the emotional pictures where displayed with mouth open. This difference in mouth opening resulted in pictures showing ambiguous expressions.

The task consisted of a practice block and two experimental blocks. The practice block consisted of 16 trials (8 models x 2 emotions). Only pictures with happy and angry affect and of 100% intensity were used to familiarize participants with the task. Each experimental block consisted of 568 trials (8 models x 4 emotions x 5 intensity levels + 8 neutral images). The order of the pictures was pseudo-randomized and equal in both blocks. Participants were instructed to indicate whether the picture looked hostile or not. In case they thought they saw a hostile picture, they were asked to press the Z-key, otherwise the M-key (on a qwerty keyboard). They had to respond as quickly as possible. The picture, size 8.5 cm x 10.5 cm, was presented for four seconds, in the center of the computer screen, against a black background. The pictures remained on the screen until a response was given or until four seconds had passed. After a pretial pause of one second, a new picture was displayed immediately. Labels were displayed in the left (Yes, hostile) and right (No, not hostile) bottom corner of the screen in white Arial font, size 30. Responses given by pressing the Z-key, indicating that the participant saw a hostile picture, were defined as “hostile” responses. If a response was not given within four seconds, the words “Too late” appeared on the screen in red. A hostile interpretation bias was defined as the percentage of “hostile” responses to the emotional pictures. The hostile responses were dummy coded (0 = no, not hostile, 1 = yes, hostile), and the mean was calculated which then immediately revealed the percentage of the pictures that were interpreted as hostile. Trials without a response (due to late responding) were not taken into account.

The Stop Signal Task (SST; Logan, 1994; Logan, Schachar, & Tannock 1997) was used to measure motor impulsivity and response inhibition. This task requires participants to make quick key responses to visually presented go signals and to inhibit any response when an auditory stop signal is suddenly presented. The go signals were arrows pointing left or right which were presented for 750ms in the center of the computer screen after the presentation of a fixation cross for 400ms. The variable time interval between the end of a go signal and the start of the fixation cross was 1000-1200ms. Participants were instructed to respond as quickly and accurately as possible on all trials by pressing the corresponding arrow on the keyboard but to withhold any response on “stop trials”. The stop signal consisted of an auditory cue, i.e. a high-pitched sound of 1000Hz. The SST used in the current study consisted of four blocks which all consisted of 60 trials. Block 1 and 2 consisted of 48 go trials and 12 stop trials. Block 2 and 3 consisted of 12 go trials and 48 stop trials. Only trials with reaction times > 550 and < 1500ms were of interest. No responses on go trials were defined as omission errors, responses to no go trials were defined as commission errors. Mean omission and commission errors were used as dependent variables.

The Continuous Performance Task (CPT) was used to measure sustained attention and response inhibition. Letters were sequentially presented on the computer screen and participants had to press the spacebar as soon as the letter-combination ‘AX’ appeared (go trial). The CPT consisted of 20 practice trials and 400 experimental trials of which 15% consisted of go trials. Each letter was presented for 200ms. The interstimulus interval was...
grooms. Only trials with reaction times > 150 and < 1500ms were of interest. No responses on go trials were defined as omission errors, responses to no go trials were defined as commission errors. Mean omission and commission errors were used as dependent variables. The CPT was found to be significantly correlated with other psychometric measures of inattention, ratings of inattention, impulsivity, and hyperactivity (Klee & Garfinkel, 1983).

The Emotional Stroop Task (EST) was used to measure attentional bias. Two versions of the EST were used: 1) aggression related words versus neutral words, 2) anxiety related words versus neutral words. All words were presented in color (red, yellow, green, blue) in the center of the computer screen and were presented for 300ms with an interstimulus interval of 1500ms. Both versions consisted of 32 trials of which 50% consisted of neutral words. Only trials with reaction times > 150 and < 1500ms were of interest. Reaction times to emotionally laden words are longer than to emotionally neutral words, as the emotional content appears to capture attention. Slowed responses are due to the emotional relevance of the word for the individual (interference (bias) effect). The EST bias score was used as dependent variable. Bias scores were calculated by subtracting the mean reaction time of the neutral words of the mean reaction time of the anxiety/aggression related words.

The Approach-Avoidance Task (AAT; Rinck & Becker, 2007) was used to measure approach and avoidance tendencies regarding emotional faces at baseline and end-of-treatment measurement. Black-white photographs (sized 8.4-13.5 cm) of facial expressions of eight actors (four men, four women) were selected from Ekman. Participants were instructed to evaluate the facial expressions (i.e. happy or angry), and to respond as fast and accurate as possible to the stimuli by either pulling or pushing a joystick. When the joystick is pulled, the stimulus grows in size, when it is pushed, it shrinks. Participants receive alternately an affect-congruent or an affect-incongruent instruction. The affect-congruent instruction indicates pulling the joystick for happy faces and pushing the joystick for angry faces. In the affect-incongruent condition the required response to the facial expression is reversed.

The AAT consisted of 6 blocks (push happy - pull neutral; pull happy - push neutral; push neutral - pull angry; pull neutral - push angry; pull happy - push angry; push happy - pull angry) of in total 288 trials. Each block was preceded by a practice block of 16 trials. During this practice block, participants received feedback in case they made an error: the picture did not disappear. The trials were semi-randomized: no more than three of the same stimulus response combination was presented successively. Each trial was self-paced: participants had to press the fire button while the joystick was in the resting (upward) position. Only trials with reaction times > 150 and < 1500ms were of interest. AAT bias scores were calculated for angry, happy and neutral faces. The individual mean reaction time for pull movements were subtracted from the individual mean reaction time for push movements. Negative scores indicate stronger avoidance whereas positive scores reflect stronger approach tendencies.

**Intervention**

All FPOs were referred to the ART. The ART as offered by “Kairos” consisted of solely two of the original modules: 1) social skills training and 2) anger control training. Moreover, a slightly adapted form of ART was offered for perpetrators of intimate partner violence which is called ‘Stop Domestic Violence’ (SDV). The SDV consisted of similar modules as the ART, in addition the partners of the FPOs were involved during the intervention (SDV; N = 58). Both the ART and SDV consisted of twelve 90-minutes weekly sessions and occurred either in groups (N = 116) or individually (N= 46). Indication for ART was determined by a multidisciplinary team. ART therapists were all formerly trained in applying the ART and, in addition, made use of a detailed intervention manual and participated in intervision.

**Procedure**

Clinicians at “Kairos” asked FPOs who were referred to ART (group or individual), whether they agreed to be contacted about the study. When they agreed, FPOs were contacted by the researcher. All FPOs, received treatment as indicated whether they participated in the study or not.

After receiving information about the nature of the study, a consent form was signed. The FPOs were screened by trained clinicians with the Research Criteria set for Intermittent Explosive Disorder (IED-IR; Coccoo, Kavoussi, Berman, & Lish, 1998), the Structured Clinical Interview for DSM-IV Axis II personality disorders (SCID-II; Weertman, Arntz, & Kerkhofs, 2000) and the MINI International Neuropsychiatric Interview (MINI; Sheehan et al., 1998; Van Vliet & De Beurs, 2007) regarding the aforementioned in- and exclusion criteria.

Once FPOs were suitable for participation they proceeded with the baseline measurement which was completed before the start of their treatment. Halfway, after 6 weeks, the level of aggressive behavior was determined by use of the SDAS. An end of treatment measurement took place after 12 weeks. The FPOs were instructed not to use alcohol or drugs 24 hours prior to any of the assessments.
Statistical analysis

First, it was examined whether FPOs who received ART as usual or ART for domestic violence perpetrators and FPOs who received group or individual ART could be considered as one sample in subsequent analyses. Therefore, a MANOVA was conducted to examine whether there were differences on the SDAS, AQ, HIT, ISS, HIBT, CPT, SST, EST, AAT and PSAP and between aforementioned groups. Bonferroni correction was used to control for multiple comparisons.

Subsequently, in accordance with Smeijers, Bultan et al. (Submitted), a linear mixed model (SPSS, version 24) was used to examine whether implicit baseline characteristics moderated the treatment response. One advantage of this analysis is that it is possible to include individuals with incomplete data (Heck, Thomas, & Tabata, 2013). As the aggression assessment half-way and end of treatment were not completed for all participants, this method was favored. The basic model was a repeated-measures design with aggressive behavior as measured with the SDAS as dependent variable and Time of measurement (baseline, half-way, end of treatment) as within-subjects factor. Repeated covariance type was set at diagonal. With respect to Time, the slope was set as a fixed effect and variation among individuals, regarding change in aggression over time, was assumed (Bolker et al., 2009; West, Welch, & Galecki, 2014). The covariance type for the random effects was set at unstructured. As our previous study already revealed that aggressive behavior reduced over the course of treatment, the main effects of HIBT, CPT, EST aggression, EST anxiety, SST and PSAP and two-way interactions of with Time were directly added to the basic model.

Subsequently, to investigate the underlying differences between FPOs who completed treatment versus FPOs who dropped out, a MANOVA regarding baseline measurements was conducted. Bonferroni correction was used to control for multiple comparisons. Finally, paired t-tests were conducted in order to examine whether end-of-treatment measurements changed as compared to baseline.

Neurocognitive Characteristics and ART

Table 3. Descriptives (Mean, SD) of the total sample, completers versus the drop-outs, baseline and end-of-treatment measurements

<table>
<thead>
<tr>
<th></th>
<th>Total sample</th>
<th>Completers</th>
<th>Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 169)</td>
<td>(N = 111)</td>
<td>(N = 58)</td>
</tr>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Social Dysfunction and Aggression Scale (SDAS)</td>
<td>15.14 (6.67)</td>
<td>15.14 (6.70)</td>
<td>15.13 (6.67)</td>
</tr>
<tr>
<td>Aggression Questionnaire (AQ)</td>
<td>22.28 (5.95)</td>
<td>22.28 (5.95)</td>
<td>22.28 (5.95)</td>
</tr>
<tr>
<td>How I Think (HIT)</td>
<td>111.02 (29.31)</td>
<td>111.02 (29.31)</td>
<td>111.02 (29.31)</td>
</tr>
<tr>
<td>Inventory of Interpersonal Problems (IIP)</td>
<td>111.78 (33.93)</td>
<td>111.78 (33.93)</td>
<td>111.78 (33.93)</td>
</tr>
<tr>
<td>Approach Avoidance Task (AAT)</td>
<td>17.28 (5.01)</td>
<td>17.28 (5.01)</td>
<td>17.28 (5.01)</td>
</tr>
<tr>
<td>Hostile Interpretation Bias (HIB)</td>
<td>10714.54 (89.47)</td>
<td>10714.54 (89.47)</td>
<td>10714.54 (89.47)</td>
</tr>
</tbody>
</table>
Neurocognitive Characteristics and ART

Effect on aggressive behavior

The basic model (Time, SDAS) showed a significant main effect of Time, indicating that aggressive behavior significantly reduced during treatment (Smeijers, Bulten, et al., Submitted). A graphic representation of the change in aggressive behavior (SDAS) is displayed in Figure 1. As an effect size is not provided by linear mixed models, Cohen’s D was calculated by dividing the mean difference between pre- post SDAS scores by the pooled standard deviation: $15.19 - 8.48 / \sqrt{(6.14^2 + 6.25^2) / 2} = 1.08$.

This basic model was extended by adding main effects of HIBT, CPT, SST aggression, EST anxiety, AAT and PSAP. A significant main effect of CPT commission errors and AAT Neutral was found, suggesting that impulsivity/attention and a stronger avoidance of neutral faces were associated with differences in aggressive behavior. Therefore, in the final model only the main effect of CPT commission errors and AAT Neutral and a 2-way interaction between CPT and Time and AAT and Time were included to examine whether treatment emerged, Wilks’ Lambda = .784, $F(20, 43) = .592, p = .897, \eta^2 = .216$; Wilks’ Lambda = .575, $F(20, 43) = .1.586, p = .102, \eta^2 = .425$, respectively. Therefore, in subsequent analyses the FPOs were considered as one sample.

Results

Table 3 displays the means on the SDAS, HIBT, CPT, EST aggression, EST anxiety, SST and PSAP. Means are presented for the total sample as well as separately for the treatment drop-outs and completers and baseline and end-of-treatment measurements.

Differences among FPOs

The MANOVA, which was conducted to investigate whether FPOs who received regular ART vs. ART for domestic violence perpetrators and FPOs who received group versus individual treatment could be considered as one sample, revealed no significant multivariate effects of ART vs. ART for domestic violence and group vs. individual treatment.

Table 4. Results of linear mixed model

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameter</th>
<th>Estimate</th>
<th>95% CI</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic model</td>
<td>Intercept</td>
<td>14.91</td>
<td>13.81 – 16.02</td>
<td>26.82</td>
<td>114.388</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Time (SDAS)</td>
<td>-3.28</td>
<td>-3.86 – -2.69</td>
<td>-11.21</td>
<td>114.199</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Model including main effects</td>
<td>Intercept</td>
<td>11.39</td>
<td>7.98 – 14.79</td>
<td>6.65</td>
<td>79.769</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>baseline characteristics</td>
<td>Time (SDAS)</td>
<td>-3.46</td>
<td>-4.17 – -2.76</td>
<td>-9.74</td>
<td>87.110</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>EST aggression</td>
<td>0.00</td>
<td>0.00 – 0.00</td>
<td>1.65</td>
<td>73.672</td>
<td>.103</td>
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<tr>
<td></td>
<td>EST anxiety</td>
<td>0.00</td>
<td>0.00 – 0.00</td>
<td>7.33</td>
<td>73.596</td>
<td>.467</td>
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<td></td>
<td>AAT_Angry</td>
<td>0.00</td>
<td>0.00 – 0.01</td>
<td>1.14</td>
<td>72.907</td>
<td>.899</td>
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<td></td>
<td>AAT_Happy</td>
<td>-0.01</td>
<td>-0.01 – 0.00</td>
<td>-1.26</td>
<td>72.563</td>
<td>.210</td>
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<td></td>
<td>AAT_Neutral</td>
<td>-0.01</td>
<td>-0.02 – 0.00</td>
<td>-2.50</td>
<td>72.637</td>
<td>.015</td>
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<td>PSAP</td>
<td>0.00</td>
<td>0.00 – 0.01</td>
<td>1.38</td>
<td>73.951</td>
<td>.171</td>
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<tr>
<td></td>
<td>HIBT_Angry</td>
<td>0.04</td>
<td>0.04 – 0.02</td>
<td>8.99</td>
<td>72.830</td>
<td>.376</td>
</tr>
<tr>
<td></td>
<td>HIBT_Happy</td>
<td>-0.08</td>
<td>-0.09 – 0.07</td>
<td>7.25</td>
<td>72.565</td>
<td>.944</td>
</tr>
<tr>
<td></td>
<td>HIBT_Fear</td>
<td>-0.05</td>
<td>-0.12 – 0.01</td>
<td>-1.48</td>
<td>73.500</td>
<td>.141</td>
</tr>
<tr>
<td></td>
<td>HIBT_Distress</td>
<td>-0.02</td>
<td>-0.07 – 0.02</td>
<td>-0.53</td>
<td>73.108</td>
<td>.592</td>
</tr>
<tr>
<td></td>
<td>CPT_Omission</td>
<td>-0.05</td>
<td>-0.10 – 0.01</td>
<td>-0.65</td>
<td>72.969</td>
<td>.516</td>
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<td></td>
<td>CPT_Commission</td>
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<td>-0.30 – 0.19</td>
<td>-3.38</td>
<td>72.752</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>SST_Omission</td>
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<td>-0.40 – 0.28</td>
<td>-0.33</td>
<td>72.857</td>
<td>.741</td>
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<tr>
<td></td>
<td>SST_Commission</td>
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<td>-0.07 – 0.17</td>
<td>0.02</td>
<td>72.881</td>
<td>.981</td>
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<td>Final model</td>
<td>Intercept</td>
<td>13.85</td>
<td>12.48 – 15.22</td>
<td>20.03</td>
<td>103.148</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>Time (SDAS)</td>
<td>-3.18</td>
<td>-3.93 – -2.42</td>
<td>-8.35</td>
<td>103.081</td>
<td>&lt; .001</td>
</tr>
<tr>
<td></td>
<td>AAT_Neutral</td>
<td>-0.00</td>
<td>-0.01 – 0.00</td>
<td>0.32</td>
<td>102.840</td>
<td>.747</td>
</tr>
<tr>
<td></td>
<td>CPT_Commission</td>
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<td>-0.03 – 0.46</td>
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<td>&lt; .001</td>
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<td>Time*AAT_Neutral</td>
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<td>-0.00 – 0.00</td>
<td>-1.34</td>
<td>102.618</td>
<td>.184</td>
</tr>
<tr>
<td></td>
<td>Time*CPT</td>
<td>-0.00</td>
<td>-0.07 – 0.06</td>
<td>-0.20</td>
<td>102.586</td>
<td>.839</td>
</tr>
</tbody>
</table>

Figure 1. Graphical representation of the change in aggressive behavior according to the self-report of FPOs (SDAS). Baseline: N = 169, SD = 6.49; week 6: N = 125, SD = 6.69; end of treatment: N = 115, SD = 6.25.
this characteristics might explain variability in aggression reduction during treatment. The analysis of the final model revealed a significant main effect of Time and CPT. No significant main effect of AAT_Neutral as well as no interaction of Time × CPT and Time × AAT (see Table 4) emerged. The results suggest that impulsivity/difficulties to inhibit behavior and avoidance tendencies of neutral faces were not related to the treatment response.

Drop-out
Means and SDs for baseline measures of treatment drop-outs and completers are presented in Table 3. No significant multivariate effect of group was found, Wilks’ Lambda = .876, F(14, 92) = .934, p = .526, η² = .124. The results suggested that treatment completers could not be differentiated from treatment drop-outs regarding neurocognitive characteristics.

Baseline versus end-of-treatment
Means and SDs for baseline and end-of-treatment measures are presented in Table 3. The results from the paired t-tests showed that only baseline scores of the AQ, HIT and IIS decreased at end-of-treatment measurement, t(113) = 5.001, p < .001; t(113) = 3.911, p < .001; and t(113) = 4.057, p < .001, respectively.

Discussion
The present study examined whether neurocognitive characteristics were associated with change in aggression during the social skills and anger control modules of the ART among FPOs displaying severe aggressive behavior. Results suggested that response inhibition was associated with change in aggression during treatment; more difficulties to inhibit responses did result in higher levels of aggressive behavior during the course of treatment. However, no interaction effects were found suggesting that response inhibition could not explain variability in aggression reduction during treatment. Our previous study found that treatment dropouts showed higher levels of proactive aggression, psychopathic traits and more weekly substance use (Smeijers, Bulten, et al., Submitted). However, in the current study, treatment completers and treatment dropouts could not be further distinguished based on underlying neurocognitive characteristics. Finally, we investigated whether end-of-treatment measurements changed as compared to baseline. Besides neurocognitive characteristics, also self-report measures were included. These analyses revealed that the disposition to act aggressively, cognitive distortions and social anxiety all decreased after the intervention. This suggests that both modules of the ART affect not only aggressive behavior but also other relevant characteristics. No differences were found regarding the neurocognitive measures.

When treating aggressive behavior, one aims not only to increase impulse control but also to affect maintaining factors in order to reduce the chance of recidivism. Indeed, the current results showed that trait aggression, cognitive distortions and social anxiety declined after treatment. The level of the neurocognitive deficits, however, remained stable and did not improve after treatment. This suggests that the ART modules did not affect these cognitive mechanisms. One may consider that ART is primarily a training of behavioral skills and does not specifically target these underlying cognitive mechanisms. It is of importance to investigate whether other forms of interventions, such as cognitive bias modification, are suitable to modify these characteristics, such as hostile interpretation or attentional biases, in order to treat aggressive behavior successfully and reduce the chance of recidivism.

The current negative results might have occurred due to a couple of reasons. First of all, the neurocognitive characteristics might be seen as general responsivity factors. It may be speculated that clinicians are able to respond to these deficits and adjust their interventions accordingly. These deficits might than not be associated with treatment outcome or drop-out but determine the implementation of the intervention. Subsequently, neurocognitive characteristics may not be associated with aggression during treatment at all. Yet, in previous research, these paradigms are often used to distinguish patient groups from healthy controls. These studies showed that individuals high in aggressive or antisocial traits display several neurocognitive deficits, such as a hostile interpretation bias towards emotional facial expressions, attentional bias towards aggressive related words and aggression on a laboratory measure (e.g. Chan et al., 2010; New et al., 2009; Smeijers, Rinck, et al., 2013). The level of the neurocognitive characteristics measured at baseline, in the current study, were comparable to these previous studies. Then, it may be the case that the paradigms used to measure these characteristics are not sensitive enough to distinguish within a subgroup of FPOs. It will be an important avenue for prospective research to elucidate these impairments in further detail and to develop paradigms which are more sensitive to measure subtle individual differences.

Furthermore, neurocognitive measurement paradigms have several advantages such as that they are less easy to control deliberately, have, for the participant, less transparent purposes, they rely less on self-report and are able to measure automatic attitudes and behavioral dispositions (Schmidt, Banse, & Imhoff, 2015). However, in order to assess the real deficits it might be conceivable that these paradigms should be made more real life like by using for instance virtual reality. The advantage of virtual reality is that they are less easy to control deliberately, have, for the participant, less transparent
Besides measurements, there are indications that these techniques may also be deployed in treatment (e.g. Rosenberg, Baughman, & Bailenson, 2013; Seitz, Poyrazlı, Harrisson, Flickinger, & Turkson, 2014). Another next step will be to develop norm scores to make it possible to measure individual patients by use of these paradigms. This will enable forensic clinical practice to make use of these paradigms, together with explicit measures, to determine deficits and select interventions in order to improve these impairments alongside general aggression treatment. In the long run, this will lead to a more successful reduction of the recurrence of aggressive behavior.

The present study and results have a number of limitations which merit further comment. First, the ART examined in the current study only consisted of two modules instead of three. Therefore, the current results are not generalizable to the use of the entire ART. Subsequently, as this was an open uncontrolled treatment study and lacked a comparison or control group the results have to interpret with care. Third, as a few women participated, the current findings may, therefore, not be generalizable to a female population with aggression regulation problems. Future research is needed to elucidate the effectiveness over a proper control condition and also more research is needed on the working mechanisms of the ART in forensic psychiatric clinical practice.

Notwithstanding the limitations and nature of the current study, the present results contribute to our knowledge of the social skills and anger control modules of the ART by showing that the ART produced not only a decline in aggressive behavior but also in the disposition to act aggressively, social anxiety and cognitive distortions in FPOs. Additionally, the reported negative results give new directions for future research; the current neurocognitive paradigms are suitable to distinguish patients from healthy controls, however, further research is warranted to develop paradigms which are more sensible to measure subtle individual differences within FPOs regarding these neurocognitive characteristics. Additionally, the use of techniques like virtual reality seems to be promising due to their enhanced ecological validity. As individuals high in aggressive behavior, as compared to healthy controls, exhibit neurocognitive deficits, it is of extreme importance to elucidate in further detail whether characteristics at a neurocognitive level are associated with treatment outcome in order to enhance the understanding of the working mechanisms of the ART in forensic psychiatric clinical practice.

References


The purpose of this dissertation was to elucidate underlying causes and maintaining factors of disproportionate aggressive behavior and to examine which characteristics were associated with treatment outcome and drop-out. First, an overview of the main results per chapter will be described. Second, I will explain in further detail how the revealed characteristics may contribute to aggressive behavior. Subsequently, treatment responsivity is questioned and discussed. Clinical implications are discussed in line with the Risk-Need-Responsivity model. Fourth, future directions are discussed and finally a brief conclusion will be provided. Table 1 provides a summary of the research aims, findings and corresponding chapters.

**Summary of the Main Results**

The development of the Hostile Interpretation Bias Task (HIBT) is described in chapter 2. When patients in forensic clinical practice are asked to indicate what happened in a situation in which they acted aggressively, they often respond with an answer like "I don’t know. He/she just looked at me". They often cannot explain in further detail how that other person looked in order to let them act aggressively. This issue, however, was not fully addressed by scientific research and was, therefore, the main purpose of the study presented in chapter 2. In this study 107 FPOs with an antisocial personality disorder (ASPD, N = 40), borderline personality disorder (BPD, N = 30) or intermittent explosive disorder (IED, N = 37) and 23 non-forensic patients with BPD, and 47 healthy non-aggressive controls participated. Results suggest that FPOs interpret facial expressions of various emotions more often as hostile than non-forensic patients with BPD and healthy controls. Moreover, the non-forensic patients with BPD, unexpectedly did not differ from the healthy controls. Additionally, this bias was associated with type and severity of aggression, trait aggression, and cognitive distortions. The results of this study suggest that a hostile interpretation bias regarding facial expressions is highly likely to be an important characteristic of disproportionate aggressive behavior.

In Chapter 3 the association between retrospectively perceived parental rejection and current self-reported aggressive behavior as well as cognitive distortions in adult FPOs displaying severe aggression was described. One hundred twenty-three FPOs filled out, retrospectively, a questionnaire about parental rejection and acceptance while growing up. First, it was revealed that cognitive distortions related to opposition-defiance (e.g. “rules are mostly meant for other people”, “If I really want to do something, I don’t care if it’s legal or not”) and to physical aggression (e.g. “people need to be roughed up once in a while”, “If people don’t cooperate with me, it’s not my fault if someone gets hurt”) were most strongly associated with current self-reported aggressive behavior. Furthermore, a direct association was found between parental rejection and the current disposition to act aggressively. Additionally, this association was partially mediated by cognitive distortions related to opposition-defiance. Taken together, the results suggest that perceived parental rejection contributes to the development of aggressive behavior and also indirectly via the emergence of cognitive distortions. The study described in this chapter supports the notion that the consequences of parental rejection during childhood are profound and can result in impairments which remain present during adulthood.

Chapter 4 describes the impact of genetics and early life traumatic events on disproportionate aggressive behavior. The focus was on MAOA-L genotype and the experience of multiple trauma types as this was associated with more detrimental consequences than the experience of a single type of trauma. Subsequently, responsiveness to treatment was explored. One hundred fifty FPOs were genotyped and filled out a questionnaire regarding traumatic events experienced before the age of 18. The results revealed that multiple types of early life traumatic experiences were associated with a higher probability of more severe aggressive behavior. Furthermore, the FPOs with the MAOA-L allele showed higher levels of aggressive behavior but did not show a more favorable or different treatment outcome.

The Reactive Proactive Questionnaire (RPQ) is used to classify aggression subtype and was originally developed for use in children and adolescents but currently also used among adults. In chapter 5, the applicability of the RPQ among adults is described. I investigated whether reactive and proactive aggression can be distinguished at a variable-based level using factor analyses and at person-based level using a latent class analysis. A variable-based approach regards to associations among variables, here the focus is on processes that are assumed to be present to a comparable degree in all members of a group. This approach treats each variable as related to each other. The person-based approach, on the other hand, examines how these variables group within individuals. It concerns individual differences; the focus is on processes that are assumed to be specific to individuals who share particular characteristics. The RPQ was filled out by male adults from forensic samples (N = 237) and from the general population (N = 278). The results suggest that the RPQ appears to be reliable for male adult samples and is able to distinguish subgroups with clinical and non-clinical levels of aggression. This distinction is based upon the severity of reported aggression and not upon the type of aggression. Therefore, the RPQ is thought to be useful in clinical practice in adolescents as well as adults to distinguish severity levels of aggression.
Besides the RPQ, the Impulsive Premeditated Aggression Scale (IPAS) is also frequently used for the bimodal classification of aggressive behavior. The terms of these classifications are often used interchangeably. In chapter 6 the correspondence between the RPQ and IPAS was examined in 161 FPOs. The results showed that the correspondence between the RPQ and IPAS was very limited and, therefore, suggest that aggression subtype as measured by use of the RPQ and IPAS are not equivalent. The RPQ seemed to assess actual aggressive behavior whereas the IPAS seemed to measure emotion and aggression regulation characteristics. In addition, the RPQ subscales are reliable in a broad range of ages whereas the impulsive subscale of the IPAS seemed to be reliable only in middle-aged FPOs.

Chapter 7 describes the investigation of the social skills and anger control modules of the Aggression Replacement Training (ART). The ART is widely used to reduce inappropriate aggressive behavior. Results regarding its effectiveness, however, are inconclusive with respect to adults and specific populations displaying clinical levels of aggression. Moreover, it is insufficiently known whether and which characteristics are associated with treatment outcome or drop-out of the ART in adults. In total 169 FPOs participated and received ART consisting of the social skills and anger control module. Measures were administered at baseline, half-way and end-of-treatment. The results of this study suggested that in this population of adults displaying severe levels of aggression, aggressive behavior decreased during the social skills and anger control modules of the ART. Moreover, higher baseline levels of trait aggressiveness were associated with a greater reduction of aggressive behavior whereas more severe cognitive distortions were associated with a less reduction of aggression. In addition, treatment drop-outs were characterized by higher levels of psychopathic traits, proactive aggression and more weekly alcohol and cannabis use.

Finally, in chapter 8, the social skills and anger control modules of the ART were investigated again but the focus was now on the associations with neurocognitive characteristics. The study population was identical to chapter 7. The results suggested that none of the neurocognitive characteristics were associated with change in aggressing during ART as well as they could not distinguish treatment completers from drop-outs. Finally, it emerged that the disposition to act aggressively, cognitive distortions and social anxiety all declined after ART but no significant changes were found regarding the neurocognitive measures.

### Table 1. Overview results.

<table>
<thead>
<tr>
<th>Research aim</th>
<th>Characteristics</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying causes and maintaining</td>
<td>Hostile interpretation bias</td>
<td>2</td>
</tr>
<tr>
<td>factors</td>
<td>Parental rejection</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Genetics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Trauma</td>
<td>4</td>
</tr>
<tr>
<td>Treatment outcome</td>
<td>Positively associated: Disposition to act aggressively</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Negatively associated: Cognitive distortions</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>No associations: Genetics</td>
<td>4</td>
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<tr>
<td>Treatment drop-out</td>
<td>Substance use</td>
<td>7</td>
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<tr>
<td></td>
<td>Psychopathic traits</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Proactive aggression</td>
<td>7</td>
</tr>
<tr>
<td>Changed during treatment</td>
<td>Aggressive behavior</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Disposition to act aggressively</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Social anxiety</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Cognitive distortions</td>
<td>8</td>
</tr>
</tbody>
</table>

### Integration and Discussion of the Results

All together the results of aforementioned studies suggest that FPOs exhibit underlying vulnerabilities which function as causes and/or maintaining factors of disproportionate aggressive behavior. According to the General Aggression Model (GAM) these underlying characteristics involve different processes/levels: hostile interpretation bias regarding emotional facial expressions is considered as a personal cause; parental rejection and trauma as environmental modifiers; and genetics is considered as a biological cause. All these characteristics might increase the likelihood of an aggressive act.

### Hostile Interpretation Bias

The impact of this bias might be rather high as it was found that this bias exists with regard to ambiguous and even less ambiguous facial expressions and to emotional facial expressions in general and not towards specific emotions. The likelihood of an aggressive act is increased because the perception of aggressive intent in others is a powerful cause of anger and aggressive behavior (Epstein & Taylor, 1967). Additionally, when attributing hostile intents to others, one is more likely to act aggressively, which in turn causes others to respond more aggressively, which will further strengthen the person’s hostile view of others (Crick & Dodge, 1996; Helfritz-Sinville & Stanford, 2014). It is also thought that aggressive prone individuals do not exhibit an interpretation bias towards anger and/or disgusted facial expressions but are rather sensitive to and better at detecting these expressions. However, a recent review suggested that this bias is not restricted to a deficit.
in selective attention (Mellentin, Dervisovic, Stenager, Pilegaard, & Kirk, 2015) which is further supported by a recent study among violent offenders (Jusyte & Schönenberg, 2016). Taken together, this leads us to suggest that in aggressive prone individuals the likelihood of aggressive behavior greatly increases as, due to the existence of this bias, these individuals tend to experience others in social interactions easily as threats/enemies. The next step will be to elucidate the development of the hostile interpretation bias. For instance, it may be wondered whether deficits in emotion recognition give rise to this bias or whether it is the other way around and whether anxiety plays a role. Furthermore, the neural underpinnings of hostility biases are yet unknown (Jusyte & Schönenberg, 2016). Future research is warranted to determine the origin of the hostile interpretation bias. This knowledge would also be beneficial for interventions targeting the interpretation of facial expressions in order to reduce this bias and consequently reduce aggressive behavior.

**Parental Rejection And Traumata**

Parental rejection is thought to be associated with negative child developmental outcomes such as an increased risk of aggressive behavior and to have an influence on the development of cognitive distortions as well. This association is still found, retrospectively, in adults which suggests that the consequences of parental rejection during childhood are profound and result in impairments which still remain present during adulthood. According to the Interpersonal Acceptance-Rejection Theory (Rohner, 2016), rejected individuals view the world as being hostile, unfriendly, threatening, untrustworthy, emotionally unsafe or dangerous in other ways. This theory further assumes that negative consequences of parental rejection, such as high tendency towards aggression, occur either because of the intense psychological pain that is produced by perceived rejection or by a phenomenon that rejected individuals protect themselves from further rejection by closing off themselves emotionally. That aggression can be used as coping or protecting mechanisms might also be applicable for the association between trauma and aggression. Early life maltreatment significantly increases risk for the development of aggressive behavior in adulthood. This risk is even higher when one experienced multiple trauma types. According to the Fear Avoidance Theory aggression may be used as emotional avoidance strategy comparable to other cognitive avoidance strategies such as distraction (Feeny, Zoellner, & Foa, 2000; Foa, Riggs, Massie, & Yarczower, 1995). The Survival Mode Theory, on the other hand, assumes that traumatized individuals enter a so called “biologically predisposed survival mode” when re-experiencing traumatic events or encounter stimuli associated with the trauma (Chemtob, Novaco, Hamada, Gross, & Smith, 1997; Novaco & Chemtob, 1998). This survival mode is comparable to the “flight or fight” response and is associated with cognitive biases which make aggressive responses more likely. Taken together, it may be suggested that parental rejection and experiencing trauma’s may result in aggressive behavior because, as a consequence, individuals develop a distorted view of the world and/or they use aggression as coping or protecting mechanism.

**Genetics:**

The X-chromosomal MAOA gene encodes the enzyme monoamine oxidase A which is responsible for the catabolism of dopamine, serotonin, as well as norepinephrine (Bortolato, Chen, & Shih, 2008; Veroude et al., 2016). It is thought that a MAOA variation might influence the activity of the serotonergic neurotransmitter system (Shiina, 2015). In specific, it is suggested that reduced MAOA activity will lead to higher levels of serotonin (van der Gronde, Kempes, van El, Rinne, & Pieters, 2014). This reduced MAOA activity is found to be associated with an increase in aggressive behavior, as also was revealed in the current dissertation. This suggest a link between high levels of serotonin and aggression however, many studies revealed that low levels of serotonin are associated with higher levels of aggressive behavior (van der Gronde et al., 2014). This contradiction is also known as the serotonin paradox and emphasizes the complexity of neurobiological causes of aggressive behavior. Moreover, the focus in the current dissertation was on the low activity variant of the MAOA gene, this, however, is not the only gene related to aggression. Examples of other genes are the 5HTLPR, COMT and DRD4. It is suggested that aggression is complex behavior and, therefore, is less likely to be explained by a few candidate genes but rather by a complex interaction between multiple genes (Vassos, Collier, & Fazel, 2014). The complexity and inconclusive results among studies provide support for future research to confirm and elucidate this association in further detail.

In the general introduction I wondered whether aggressive individuals show this behavior on purpose, whether aggression is in their nature and what triggers such deviant behavior. Based on the studies described in this dissertation we now can answer these questions partially. According to the General Aggression Model (GAM; Anderson & Bushman, 2002; DeWall, Anderson, & Bushman, 2011) the current dissertation first revealed a personal factor contributing to aggressive behavior namely the existence of a hostile interpretation bias towards emotional facial expressions. This finding suggests that facial expressions are not processed accurately and that this occurs relatively without conscious introspection. This provides support for the idea that at least a part of social information is not processed correctly which is in correspondence with the Social Information Processing Model (SIP; Crick & Dodge, 1996). Subsequently, environmental modifiers as well as a biological factor were revealed. All these factors may play an important role in the development and maintenance of aggressive behavior. Taken together, these results suggest that aggressive behavior cannot be fully explained based on biological factors and that it,
therefore, cannot be stated that aggression is purely in someone’s nature. On the other hand, it might be argued that a genetic disposition may be accountable for individual differences in the disposition to aggression. However, it seems to be a complex interplay between these, and probably even more, characteristics which together contribute to the development and maintenance of aggressive behavior. The studies in the current dissertation all focused just on one of these contributing factors. For future research, it would be highly interesting to elucidate the cumulative and the interaction effects between these characteristics in order to enhance the understanding of the development of severe aggressive behavior.

**Bimodal Classification of Aggressive Behavior**
The bimodal classification of aggressive behavior is a frequently studied topic and is, furthermore, also of clinical relevance. The behavioral, cognitive and emotional antecedents and consequences are different among these subtypes. These differences have implications regarding diagnosis, prevention, and treatment (Babcock, Tharp, Sharp, Heppner, & Stanford, 2014). For clinical practice it is, therefore, of great importance to assess the presence of these subtypes correctly. This, however, may not as easy as it seems. The Reactive Proactive Questionnaire (RPQ), one of the most frequently used instruments to classify aggression subtype, was found to mainly distinguish aggression severity than subtype. Also the Impulsive Premeditated Aggression Scale (IPAS) could not distinguish FPOs solely based on aggression subtype. The terms of the RPQ and IPAS are often used interchangeably. However, together with the study by Teten Tharp et al. (2011) the current dissertation showed that there was relatively low correspondence between the questionnaires. This might suggest that both questionnaires measure a distinction in aggression but that the subtypes are not equivalent. This finding has implications for research as well as clinical practice. For instance, results associated with or interventions on reactive aggression might not apply to impulsive aggressive behavior. In order to make the right judgments or select the correct interventions, it needs to be clear which questionnaire can be used for which samples and for which purposes. Chapter 5 and 6 of the current dissertation suggest that the RPQ is reliable for use in adults and the IPAS for use in middle-aged individuals. Furthermore, the RPQ focuses more on actual aggressive behavior whereas the items of the IPAS are more related to emotions and their regulation. However, more research is needed to confirm and elucidate this distinction. Furthermore, to use these questionnaires at an individual level norm scores need to be developed. This would enable forensic clinical practice to determine whether the level of the aggression subtype is relatively low, medium or high. This knowledge, subsequently, might be used to select and compose interventions.

**Treatment and Implications for Forensic Clinical Practice**
Quotes of several FPOs, who participated in the study, about their experience with aggression treatment:

“\[I have learned about the origin of my aggression.  
Now I know how to take a time-out and I have learned to recognize when I become aggressive but also when others become aggressive\]”

“\[Before, I immediately was prepared to use aggression.  
Now, I’ am able to take distance\]”

“One training is not enough to develop all the necessary skills.  
Now I know more about my aggression, I would like to do the training again so I really can control my impulses”

Although the present study was not designed to investigate the effectiveness of the Aggression Replacement Training (ART), the results give some indication of the usage of the ART among adult FPOs with severe aggressive behavior. The citations of the FPOs described above are positive and seem to suggest a successful intervention. Indeed, in the current dissertation a decline in aggressive behavior as well as in the disposition to act aggressively, social anxiety and cognitive distortions was observed. This suggests that the social skills and anger control modules may be considered as successful interventions for use in this specific population of FPOs. However, future research is warranted to replicate this finding in comparison to a proper control condition. On the other hand, aggressive behavior decreased significantly but the level of aggression at end of treatment measurement was still relatively high and not comparable to the level reported by healthy controls assessed in chapter 2. Furthermore, after completing the ART, the majority of the FPOs (N = 82) received another additional treatment, with the aim to further decrease the disposition to act aggressively. Taken together, this might suggest that ART in many patients is not sufficient enough to treat disproportionate aggressive behavior. Future research should include follow-up measurements. It would be of great importance to investigate whether improvements regarding aggressive behavior endure over time. Furthermore, it needs to be elucidate which characteristics can predict recidivism and can predict a successful treatment over time.
Discussion

Subsequently, the ART was found to be most applicable to a subgroup of FPOs high in trait aggression, with few cognitive distortions, low in psychopathic traits, proactive aggression and substance use. In addition, it emerged that the disposition to act aggressively was positively associated with treatment outcome. This finding corresponds with previous research (Hornsveld, 2005). It suggests that individuals who needed treatment most also benefit from it most. A possible explanation for this finding is that these FPOs do not only learn skills but also develop more knowledge of impulse control and alternative behavioral responses. It is thought that the acquisition of knowledge makes the cognitive system more flexible as it now has more representations of the environment and more ways to achieve a particular behavioral outcome (Lövdén, Bäckman, Lindenberger, Schaefer, & Schmiedek, 2010). As a result, disproportionate aggressive and antisocial behavior may be strengthened and/or maintained. The presence of many cognitive distortions might then hamper the development of skills and knowledge about gaining control over aggressive impulses. Moreover, the ART investigated in the current dissertation did not include the moral reasoning module. This module focuses specifically on moral reasoning and cognitive distortions. Based on the negative associations between cognitive distortions and treatment outcome it might be advised to include this or a comparable module in order to focus more on altering these self-serving cognitive distortions. On the other hand, it also was revealed that cognitive distortions decreased after treatment. This might indicate that treatment in FPOs with low or medium levels of cognitive distortions does not need to be specially focused on these distortions in order to alter them whereas for FPOs high in cognitive distortions this extra focus probably is needed. This idea supports the notion that it is important to assess FPOs before treatment selection. This would enable forensic clinical practice to identify the FPOs who might need additional interventions to alter cognitive distortions in order to decrease aggressive behavior.

Besides the characteristics investigated in the current dissertation, a lot more factors are of relevance with regard to aggressive behavior and treatment responsivity. For instance, pharmacotherapy is often offered as co-treatment, also the majority of the FPOs used medication. The FPOs in the current dissertation, however, did not start or change their pharmacotherapy relating to aggressive behavior in order to minimize moderating effects. Also comorbidity rates in forensic mental health settings are very high. For example, with attention deficit hyperactivity disorder (ADHD), autism spectrum disorders, mental disability and anxiety. The current dissertation, however, had a transdiagnostic perspective on aggressive behavior in order to reveal associations which are generally valid for the pathology of aggression regardless diagnosis. These are just a couple of examples, when investigating aggressive behavior one needs to be aware of the complexity of the pathology and all the different factors and processes involved.

Future Directions

Risk-Need-Responsivity (RNR) model

The RNR model focuses on offender rehabilitation and is considered as one of the premier treatment models for offenders. The model consists of three principles: 1) risk principle, proposing that offenders at higher risk for reoffending will benefit most from more intensive treatment; 2) need principle, stating that only those factors associated with reductions in recidivism should be targeted during treatment; and 3) responsivity principle, suggest that interventions should be matched to offender characteristics such as level of motivation, personal circumstances and learning style. The characteristics associated with aggressive behavior, treatment outcome and drop-out, studied in the current dissertation, focuses mainly on the need and responsivity principle.

The current knowledge derived about the characteristics associated with treatment outcome is helpful to make an informed decision whether ART is suitable for a specific individual patient and to develop personalized treatment. In order to do so, assessment of the individual FPO should occur during the screening phase and before treatment selection. Subsequently, when specific deficits can be found, interventions may be selected in order to improve these individual impairments with individual sessions alongside general aggression treatment. This will result in more targeted treatments which are further aimed at, and probably also more successful in, reducing aggressive behavior. In other words, it is suggested to focus on factors most strongly associated with aggression in order to alter and reduce this behavior (need principle according to the RNR model). In the long run, this also might enhance treatment adherence and maybe as a result decrease dropout rates. However, in order to develop personalized treatment, more research is needed in order to replicate and extent the current findings. Another...
Discussion

next step would be the development of norm scores in order to be able to make use of the questionnaires and paradigms to measure aggression relevant characteristics at an individual level.

Furthermore, pre-treatment assessments could also be used to indicate the chance of drop-out. This might be of extreme importance as drop-out rates in forensic mental health settings are extremely high (Hornsveld, Nijman, Hollin, & Kraaimaat, 2008). Regarding dropout rates, as suggested in chapter 6, it seem to be important to pay special attention to treatment motivation. In other words, the intervention should be matched to the individuals characteristics (responsivity need according to the RNR model). Treatment motivation is associated with treatment-related behavior such as compliance, engagement and adherence and is therefore, considered to be a crucial factor related to treatment outcome (Drieschner, Lammers, & van der Staak, 2004). One of the techniques which can be used to increase treatment motivation is motivational interviewing (MI). MI is a directive, client-centered, method for improving intrinsic motivation to change through exploring and resolving ambivalence (Miller & Rollnick, 2002). Often, MI has three main purposes: enhance retention and engagement in treatment, improve motivation to change and change behavior (McMurran, 2009). Previous studies have shown that MI improved treatment adherence and the motivation to change in criminal offenders, perpetrators of interpersonal violence and individuals with substance use disorders (Crane & Eckhardt, 2013; Doran, Luczak, Bekman, Koutsenok, & Brown, 2012; Dunn, Deroo, & Rivara, 2001; Feldstein & Ginsburg, 2006; Mauro & Murphy, 2009; McMurran, 2009). Further research is needed in order to elucidate what form of MI is best suitable among severely aggressive FPOs. It needs to be investigated whether MI has to be provided as group or individual pre-intervention or whether it has to occur simultaneously with an aggression intervention and how many sessions are desirable.

Alternative Interventions
Previous studies showed that individuals with aggressive, antisocial and psychopathic traits exhibit neurocognitive deficits and impairments. In the current dissertation, however, no such impairments could be found within a population of FPOs, with the exception of the hostile interpretation bias. Moreover, it was found that the hostile interpretation bias did not change after treatment. As the ART is a skills training, it may be suggested that it intervenes less on underlying, implicit, characteristics. One might argue that when leaving these underlying causes and maintaining factors untreated aggressive behavior is lurking in highly provoking and frustrating situations. Alongside ART, other interventions need to be developed in order to alter these underlying neurocognitive characteristics. To develop these additive or alternative interventions other techniques than cognitive behavioral therapeutic techniques need to be used, which will further be explored in subsequent sections.

Cognitive Bias Modification
In the current dissertation a hostile interpretation bias was revealed and, furthermore, previous studies have suggested that aggressive and antisocial individuals display several other cognitive biases. It was also revealed that the ART did not change cognitive biases, therefore it is of extreme importance to explore other techniques to alter these biases. Procedures to manipulate and alter cognitive biases often make use of Cognitive Bias Modification (CBM). The notion behind CBM is to expose individuals to an experimentally established contingency during performance of a simple task which is designed to attenuate the target selective processing bias (Koster, Fox, & MacLeod, 2009). Previous research showed that it is possible to modify biases in emotion recognition and to improve facial affect recognition after a brief computerized CBM-training (Penton-Voak et al., 2013; Schönenberg et al., 2014). Furthermore, it also was found that CBM-training in which participants learnt to interpret scenarios positively was effective in reducing angry reactions to an ambiguous interpersonal insult (Hawkins & Cougle, 2013). The results of this study are promising by revealing that anger can be reduced by decreasing a cognitive bias. As the hostile interpretation bias towards emotional facial expressions, revealed in the current dissertation, is considered to be an important underlying mechanism of aggressive behavior, it would be of great importance to elucidate whether a CBM-training is able to reduce this bias and whether that also is associated with a decrease in aggressive behavior. For example, a study might be conducted in which treatment as usual versus treatment as usual with additional CBM-training will be investigated. Interventions with CBM as one of the key elements might be innovative with regard to effectiveness of aggression treatment. In the long run, interventions that alter the hostile interpretation bias help to reduce the recurrence of aggression more successfully.

Virtual Reality
A possible explanation for the negative results regarding the neurocognitive characteristics is that the current paradigms are not sensitive enough to measure subtle individual differences and exhibit insufficient ecological validity. It also may be the case that the role of contextual cues need to be considered. This is thought to be of particular importance regarding the processing of facial expressions (Wieser & Brosch, 2012). It, however, also might be of relevance regarding aggression in general as aggressive behavior often occurs in response to certain social situation in which contextual cues play an important role. Furthermore, one might suggest that the paradigms should be made more real life like. A technique which is able to include contextual cues as well as more real life situations
Discussion

is virtual reality. The advantage of virtual reality is that underlying mechanisms can be investigated in controlled experimental designs but with enhanced ecological validity (for review see Parsons, 2015). Another advantage of this technique is that it can be combined with psycho-physiological measures, such as heart rate, skin conductance and eye tracking. Also in forensic psychiatry virtual reality has been used and seems to be promising (Benbouri, Nolet, Trottier, & Renaud, 2014). Besides measurements, there are indications that these techniques may also be deployed in treatment. For instance, virtual reality is found to be binding during posttraumatic stress symptoms (Seitz, Poyrazli, Harrisson, Flickinger, & Turkson, 2014). Furthermore, Rosenberg, Baughman, and Bailenson (2015) suggested that experiences in virtual reality can be used to increase pro-social behavior which is highly relevant for the treatment of aggressive behavior. Virtual reality interventions let patients practice with alternative behavior responses. Furthermore, regarding aggressive individuals, they can practice aggression control skills in unexpected situations. It would be highly interesting to investigate whether virtual reality aggression treatment is effective in decreasing aggressive behavior.

Conclusion

Considering the enormous health, social and economic consequences of aggression, there is a critical need for a better understanding of underlying causes and maintaining factors as well as of effective treatments of maladaptive aggressive behavior. This dissertation contributes to the enhancement of this understanding by revealing several underlying causes as well as maintaining factors of severe aggressive behavior displayed by FPOs. Furthermore, it highlighted the complexity of disproportionate aggressive behavior and the vulnerability of FPOs. Moreover, it was revealed that aggressive behavior decreased during treatment but that not every FPO benefitted from treatment. Multiple characteristics emerged to be associated with either treatment outcome or with treatment drop-out. However, no neurocognitive characteristics were found to be associated with treatment outcome or drop-out. Future research is warranted in order to examine individual differences within the subgroup of FPOs at a neurocognitive level and to develop paradigms with enhanced ecological validity. Moreover, as the current treatments, which mainly involve skill training, are not suitable or developed to alter implicit characteristics, other methods are needed to improve the efficacy of aggression treatment. Techniques like CBM and virtual reality seem to be promising. All in all, disproportionate aggressive behavior is a complex phenomenon with detrimental consequences. This dissertation, however, revealed that it is a treatable condition and offers suggestions in how to reduce aggressive behavior even more successfully. The work presented in this dissertation contributes to incorporating scientific research in forensic clinical practice.

References

Discussion


Nederlandse Samenvatting

Dankwoord

Curriculum Vitae
Nederlanse samenvatting

Ernstig Agressief Gedrag
Naar het begrijpen van enkele onderliggende kenmerken en behandelrespons

Onder agressie verstaan we elk gedrag dat gericht is op mens, dier of voorwerpen met de intentie om schade toe te brengen. Helaas komt agressief gedrag vaak voor en heeft het veel negatieve gevolgen. Zo kan het traumatisch zijn voor slachtoffers en getuigen maar daarnaast heeft het ook negatieve gevolgen voor de dader en zelfs voor de samenleving in het algemeen. Het is van groot belang dat er meer kennis wordt ontwikkeld over de onderliggende factoren die bijdragen aan het ontstaan en in standhouden van agressief gedrag. Deze kennis kan bijdragen aan het succesvol verminderen van agressie. Als het gaat over agressievermindering is er momenteel nog onvoldoende kennis over hoe agressie het beste kan worden behandeld bij volwassenen met ernstige agressieproblematiek. Het doel van deze dissertatie is in deze studie zijn ambulant forensisch psychiatrische patiënten met agressie-regulatie-problematiek. Per hoofdstuk zullen nu de resultaten worden besproken.

In hoofdstuk 2 wordt een onderzoek besproken waarin een taak ontwikkeld is om een “vijandige interpretatie bias” te meten. Deze bias verwijst naar de neiging die individuen op voorhand kunnen hebben om emotionele gezichtsuitdrukkingen te interpreteren als vijandig, ook al zijn ze dat niet. Dergelijke biases kunnen belangrijke oorzaken zijn van agressief gedrag. In dit onderzoek werden drie groepen onderzocht: ambulant forensisch psychiatrisch patiënten met ernstige agressieproblematiek gediagnosticeerd met antisociale of borderline persoonlijkheidsstoornis of de periodeke explosieve stoornis, niet forensische patiënten met een borderline persoonlijkheidsstoornis en een groep gezonde, niet agressieve, controles. De resultaten wezen uit dat de forensische patiënten emotionele gezichtsuitdrukkingen vaker als vijandig interpreteerden in vergelijking met de twee andere groepen. De niet forensische borderline patiënten presteerden vergelijkbaar met de gezonde controles. Op basis van deze studie wordt verondersteld dat deze vijandige interpretatie bias een belangrijke kenmerk is van forensisch psychiatrische patiënten met ernstig agressief gedrag.

In hoofdstuk 3 wordt beschreven hoe ouderlijke afwijzing samenhangt met agressief gedrag. Onder ouderlijke afwijzing wordt verstaan weinig warmte en een hoge mate van vijandigheid/agressie en verwaarlozing. Dit werd retrospectief gemeten. De resultaten lieten zien dat ouderlijke afwijzing, ervaren door de patiënt, op twee manieren bijdraagt aan agressief gedrag: direct en indirect. Ouderlijke afwijzing heeft een direct verband had met huidig agressief gedrag. Daarnaast werd er ook een indirecte link gevonden via cognitieve vertekeningen. Deze verwijzen naar onjuiste attitude, gedachten of overtuigingen met betrekking tot andermans of eigen gedrag. De gevonden indirecte link houdt in dat ouderlijke afwijzing is gerelateerd aan meer cognitieve vertekeningen en dat ook deze cognitieve vertekeningen geassocieerd zijn met agressief gedrag. Samenvattend laten de resultaten van dit onderzoek zien dat de gevolgen van ouderlijke afwijzing waarschijnlijk persistent zijn en nog steeds invloed hebben in de volwassenheid.

In hoofdstuk 4 wordt gekeken naar een mogelijk biologische oorzaak voor agressief gedrag. In de literatuur wordt verondersteld dat agressie ontstaat door de interactie tussen genetica en ongunstige gebeurtenissen in het verleden. Dit betekent dat als een persoon een genetische kwetsbaarheid heeft en negatieve levensgebeurtenissen heeft meegemaakt, de kans op agressief gedrag groter is. Deze interactie werd in deze studie onderzocht bij ambulant forensisch psychiatrische patiënten met ernstig agressief gedrag. De focus lag hierbij op het volgende gen: MAOA-L. Gevonden werd dat patiënten met dit gen variant meer agressie rapporteerden. Daarnaast werd ook gevonden dat patiënten die meerdere verschillende soorten trauma’s hebben meegemaakt, meer agressie lieten zien. Er werd echter geen bewijs gevonden voor een interactie effect. Daarnaast is er gekeken of patiënten met het MAOA-L genotyp een ander behandeling heeft. Er werd echter geen bewijs gevonden voor een ander behandelbeloop voor patiënten met het MAOA-L gen.

Bij agressief gedrag wordt vaak een onderscheid gemaakt tussen impulsief en gepland gedrag. Dit noemen we reactieve of impulsieve agressie en proactieve of agressie met voorbedachten rade. Om dit onderscheid te meten wordt vaak de Reactive Proactive Questionnaire (RPQ) gebruikt. Deze lijst is van origine ontwikkeld voor gebruik bij kinderen en adolescenten maar wordt ook gebruikt bij volwassenen. In hoofdstuk 5 werd de toepasbaarheid van de RPQ bij volwassenen onderzocht. In dit onderzoek namen mannen deel vanuit forensisch psychiatrisch instellingen en de algemene populatie. De resultaten van dit onderzoek wezen uit dat de RPQ ook betrouwbaar is bij volwassenen en de lijst een onderscheid kan maken in ernstniveaus van agressie.
De studies in deze dissertatie geven inzicht in onderliggende oorzaken en in stand houdende factoren van ernstig agressief gedrag. Daarnaast geeft het een eerste indicatie voor welk type patiënt behandelingen zoals de ART het meest geschikt is. Zo weten we nu dat patiënten met een grote neiging tot agressief gedrag, weinig proactieve agressie en cognitieve vertekening, weinig middelen gebruik en een lage mate van psychopathie, het meeste baat hebben bij de behandeling. Deze kennis kan in de toekomst worden gebruikt om patiënten voorafgaand aan de behandeling te screenen. Er kunnen dan interventies worden ingezet om bovenstaande kenmerken te verminderen voordat iemand aan de ART begint. Het is denkbaar dat dit resulteert in een meer succesvolle behandeling van agressief gedrag. Daarnaast geeft het aan dat er andere technieken nodig zijn om de uitval te verlagen. Hierbij kan gedacht worden aan technieken als motivationele gespreksvoering. De nul bevindingen die we hebben gedaan op het gebied van neurocognitieve eigenschappen laten zien dat we in de toekomst mogelijk gebruik moeten maken van andere technieken, zoals virtual reality, die beter in staat zijn om subtiele verschillen binnen dergelijke patiënten groepen te vinden en te kunnen meten.

Hoofdstuk 7 beschrijft een onderzoek naar een agressie-interventie. Deze interventie bestaat uit de sociale vaardigheden en boosheidsregulatie modulen van de Aggression Regulation Training (ART). Dit onderzoek is uitgevoerd omdat de ART een veel gebruikte interventie is terwijl we weinig weten over de effectiviteit bij volwassenen. In dit onderzoek namen in totaal 169 ambulant forensisch psychiatrische patiënten deel welke voor, halverwege en na hun behandeling werden gemeten. De resultaten wezen allereerst uit dat agressie gedurende de behandeling afneemt. Daarnaast bleek dat patiënten met een grote neiging tot agressief gedrag een snellere afname in agressie lieten zien. Patiënten die daarentegen veel cognitieve vertekeningen hebben lieten een minder snelle afname zien. Ook bleek dat patiënten die voortijdig met de behandeling waren gestopt, meer alcohol en cannabis gebruikten, meer psychopathische trekken vertoonden en meer proactieve agressie lieten zien.

Tot slot, in hoofdstuk 8, werd de ART nogmaals onderzocht maar nu met betrekking op neurocognitieve eigenschappen. Deze verwijzen naar onderliggende mentale capaciteiten die minder bewust en meer automatisch van aard zijn, zoals impulsiviteit en cognitieve biases. Het is van belang ook deze eigenschappen te bekijken omdat dit nog meer inzicht geeft in de onderliggende mechanismen van agressie en de behandeling ervan. De resultaten van dit onderzoek wezen uit dat neurocognitieve eigenschappen niet samenhangen met afname van agressie gedurende de behandeling. Ook konden ze geen onderscheid maken tussen de patiënten in behandeling en de patiënten die voortijdig waren gestopt. Dit onderzoek liet wel zien dat naast een afname in agressie, ook sociale angst, de neiging tot agressief gedrag en cognitieve vertekening afnamen gedurende de ART.
Dankwoord

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Curriculum Vitae

Danique Smeijers was born on June 27, 1988 in Veghel, The Netherlands. In 2006 she started her psychology study at the Radboud University Nijmegen. She successfully followed the Research Master program of Behavioral Science in 2011 and the Master Clinical Psychology in 2012 both at the Radboud University Nijmegen. From December 2012 till December 2016 she worked on her PhD project at the department of psychiatry of the Radboud UMC and the Pompestichting. During her PhD project as well as currently she is also affiliated to the Radboud University Nijmegen as lecturer. Danique was awarded for her presentation at the XXII conference of the International Society for Research on Aggression with the Kirsti M.J. Lagerspetz Award for an outstanding presentation.

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Smeijers, D., Brazil, I., Bulten, E., & Verkes, R.J. Retrospective Parental Rejection is Associated with Aggressive Behavior as well as Cognitive Distortions in Forensic Psychiatric Outpatients. Revision submitted in Psychology of Violence.

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