Chapter 1

General Introduction
Introduction

There is a long history on how to ‘treat’ criminal behavior. Ranging from strongly religion-oriented programs in the early 1900s, to the raise of individualized intervention programs in 1960, through the rejection of nearly all treatment programs by many political parties in the 1970s as hardly any program appeared to be effective in reducing crime (for a historical overview see, Cullen & Gendreau, 2000). However, these former rehabilitation programs were not guided by underlying, coherent frameworks, or theoretical bases. During the 1980s and 1990s, meta-analytic methods were introduced, revealing several factors that were positively related to recidivism reduction. Since then, there has been a shift in criminal justice thinking from nothing works to what works (Andrews, 1995; Gendreau, Little, & Goggin, 1996; Lipsey & Wilson, 1993). Consequently, rehabilitation models were introduced, aiming to target these specific recidivism-related factors, including criminogenic needs, such as substance abuse and family factors. Of these models, the ‘Risk-Need-Responsivity’ (RNR) model is currently most prominent in guiding effective reduction of criminal behavior (Andrews, Bonta, & Wormith, 2011; Andrews, 1995; Andrews & Bonta, 2010; Andrews & Dowden, 2007; Ward, Melser, & Yates, 2007).
The RNR model is characterized by a strong basis in personality and psychosocial perspectives on human behavior and suggests that behavioral intervention programs, especially those based on cognitive-behavioral therapy (CBT) techniques, are most effective in influencing factors that are known to predict recidivism (Andrews & Bonta, 2010). Indeed, meta-analytic studies confirm the positive influence of CBT-derived interventions on recidivism rates in both adolescents and adults (Genoves, Morales, & Sanchez-Meca, 2006; Lipsey & Cullen, 2007; Lipsey, Landenberger, & Wilson, 2007; Pearson, Lipton, Cleland, & Yee, 2002). All in all, the historical struggle with correctional rehabilitation programs seems to have ended with a moderately effective intervention approach for criminals.

Nevertheless, meta-analytic research does not only show the average positive effects of CBT-based intervention programs on recidivism rates, but there also appears to be a large amount of variation in effectiveness across different interventions and different studies. In fact, some studies revealed almost a 50% reduction, while others found less than 10% decrease in criminal recidivism (for meta-analysis see, Lipsey & Cullen, 2007). Of course, a certain amount of that variability reflects statistical noise and unsystematic differences in study procedures and methods. However, Lipsey and Cullen (2007) stated that much of it is related to substantive characteristics of the treatment and offender samples to which the interventions are applied. Overall, the varying results suggest that there is still a relatively large group of offenders who do not benefit from correctional intervention.

There are serious political, societal, and scientific needs to unravel why some offenders benefit from intervention, and others do not in order to develop effective intervention methods to reduce criminal recidivism rates. While the historical influences on rehabilitation programs still dominate the correctional field, this dissertation argues that clinging to traditional ideas about how to best treat antisocial behavior will hamper the improvement of correctional rehabilitation assessment and intervention. In other words, there is need for a different, modern view on correctional rehabilitation. In the following section, a neurobiological perspective on crime will be briefly introduced as an additional approach to better understand the wide variation in effectiveness of correctional rehabilitation programs.

The neurobiological perspective on antisocial behavior has received increased attention over the past three decades. New insights through the development of innovative methods, such as brain imaging techniques, have led to a greater acceptance of neurobiology as an additional approach for the study of criminal behavior. In populations with severe antisocial behavior, impairments in different biological systems, including poor
neurocognitive functioning, low autonomic nervous system activity, and deviant hormone levels have been found (e.g., Beauchaine, Hong, & Marsh, 2008; De Kogel, 2008; Lorber, 2004; Ogilvie, Stewart, Chan, & Shum, 2011; Wilson & Scarpa, 2012; Yang & Raine, 2009). Not only have empirical studies increased insight into the neurobiological correlates of antisocial behavior, it also appears that specific neurobiological deficits are precursors of antisocial development and reoffending rates (Aharoni et al., 2013; Gao, Raine, Venables, Dawson, & Mednick, 2010; Jennings, Piquero, & Farrington, 2013; Pardini, Raine, Erickson, & Loeber, 2014; Raine et al., 2005; Van Bokhoven, Matthis, Van Goozen, & Van Engeland, 2005). Furthermore, it has been suggested that certain neurobiological characteristics, such as poor frontal brain functioning, may impair specific cognitive and emotional processing, which play a central role in responsivity to correctional interventions (Fishbein et al., 2006; Van Goozen & Fairchild, 2008).

In the Netherlands, the need of a neurobiological perspective on crime-related problems has been recognized by various societal institutions (De Kogel, 2008). As a result, in 2010 an extensive national research program called “Brain & Cognition – Societal Innovation in Health, Education, and Social Safety” was launched with the combined forces of societal and scientific partners. The Research and Documentation Centre (WODC) of the Dutch Ministry of Security and Justice played a vital role in the realization of several research projects within the Pillar Social Safety, including the current research project.

This dissertation concerns the added value of neuroscience to better understand the effectiveness of correctional rehabilitation. Specific research questions and corresponding methods will be investigated to eventually examine in what way intervention-related factors might benefit from neurobiological insights. A first factor concerns the treatment selection procedure. Treatment effectiveness is partly influenced by how well offenders are selected for intervention. Although valid and reliable assessment instruments have been developed, such as the Offender Assessment System (OASys; Howard, Clark, & Garnham, 2003), these instruments are highly influenced by the traditional psychosocial perspectives on criminal behavior (Mair, Burke, & Taylor, 2006). The current dissertation investigates whether neurobiological factors are related to correctional treatment outcome and in what way they could contribute to a better selection procedure.

Furthermore, the contents of cognitive-behavioral intervention programs also mainly focus on improving psychological and social criminogenic characteristics, such as thinking style and relationships with others (McDougall, Perry, Clarrbour, Bowles, & Worthy, 2009; Vaske, Galyean, & Cullen, 2011). In addition, although CBT appears to be the most accepted and validated correctional intervention program, it is a group-oriented, ‘one size fits all’
intervention where all participants are required to complete similar modules despite individual differences in psychological, social, but also neurobiological characteristics. Results from this dissertation might reveal additional neurobiological criminogenic needs that could be targeted during correctional intervention in order to effectively reduce antisocial behavior.

Finally, treatment efficacy is often expressed in recidivism rates. Although this approach may provide insight into the extent to which treatment affects reoffending, it does not explain why treatment is effective. In other words, the underlying working mechanisms of intervention remain unknown when treatment outcome is expressed in recidivism rates. Proximal treatment outcome measures, on the other hand, can shed more light on how intervention decreases criminal behavior. Examples of proximal measures are self-report questionnaires, such as the Eysenck Impulsivity Scale (Buysse & Loef, 2012; McDougall et al., 2009). Nevertheless, there are serious limitations to self-report questionnaires when measuring treatment outcome, such as social desirability and poor verbal intelligence skills (Sibley et al., 2010). In addition, it has been argued that a successful change in behavior due to psychotherapy, will lead to long-term structural and functional changes in the brain (Kandel, 1998). For these reasons, this dissertation examines whether neurobiological measures could function as additional and alternative treatment outcome indicators.

Box 1. Antisocial Behavior
In this dissertation the term *antisocial behavior* is used as an umbrella term referring to all kinds of norm-violating behavior. This includes clinical constructs, such as antisocial personality disorder and oppositional defiant disorder; legal constructs, including delinquency or criminal behavior; and specific types of antisocial behavior, such as aggressive behavior. These are frequently-used operationalizations of antisocial behavior in the scientific literature on the relationship between antisocial behavior and neurobiological factors.
The Current Study

The purpose of this dissertation is to investigate the relationship between neurobiological factors and prisoners’ response to a cognitive skills training program and to examine to what extent knowledge about this relationship could be used to improve correctional rehabilitation. To investigate this objective, two main research questions were formulated. The first question is as follows: What is the predictive value of neurobiological factors...

Box 2. Neuroscience

This dissertation draws from the field of neuroscience which is an interdisciplinary science referring to the broad study of the nervous system. The term neurobiology refers specifically to the biology of the nervous system and therefore functions as an umbrella term referring to all kinds of biological processes regulated by the nervous system. Examples of neurobiological factors are heart rate activity, hormone production and brain functioning. Some of the methods to assess neurobiological factors, such as brain imaging techniques, are quite invasive and used in more controlled, clinical research settings. In order to assess brain functioning in the current study, we draw our methods from the field of neuropsychology. This branch is closely related to the broader field of psychology and refers to the study of how the functioning of the brain relates to an individual's cognition and behavior. Tasks that indirectly measure brain functioning are often called neuropsychological, or neurocognitive tasks. An example of such a task is the go/no-go task that assesses response inhibition (by presenting subjects with a binary decision on each stimulus) and appears to activate specific prefrontal-parietal brain circuits (Simmonds, Pekar, & Mostofsky, 2008). Finally, the term cognition is a psychological term and refers to mental processes including thoughts, beliefs, memory and attitudes. Cognitive measures are generally designed to uncover mental abilities rather than measuring underlying brain processes.

Overall, central to this dissertation is the fact that specific (crime-related) concepts, such as impulsive behavior, can be assessed from different perspectives. From a neurocognitive perspective, impulsive behavior can be measured using the go/no-go task whereas the cognitive, or mental, aspect of impulsivity can be assessed with help of self-report questionnaires (e.g., Eysenck Impulsivity Scale). Finally, specific physiological processes, such as low resting heart rate, appear to be associated with impulsive sensation-seeking behavior (Portnoy et al., 2014). Instead of viewing these measurement methods as mutually exclusive, they could function as complementary measures since they reveal information about specific behavior from different ‘sources’. In this dissertation it is argued that this multidimensional ‘biopsychosocial’ perspective in particular may be helpful to increase our understanding of criminal behavior.
in relation to the outcome of a cognitive skills program for adult prisoners? Investigating this relationship might reveal which neurobiological characteristics are associated with treatment benefit and which characteristics are related to a poor treatment response. In other words, this might provide more insight into who is able to successfully benefit from therapy and who is not, from a neurobiological perspective. Results might provide insight into how to improve the current selection procedure with help of neurobiological knowledge. The second question is the following: Do prisoners’ neurobiological factors change in response to a cognitive skills training program? Studying this issue may provide more insight into why intervention is effective in reducing crime. What are the underlying neurobiological mechanisms that prevent someone to benefit from therapy? The answer to this question could reveal more information about the working mechanism of current treatment options and the ways in which neurobiological information could help to improve treatment content, and might lead to the development of alternative intervention programs.

Different study methods were employed to investigate the main research questions of this dissertation. Literature reviews were conducted on the predictive value of neurobiological factors in relation to treatment outcomes of individuals with antisocial behavior (Chapter 2) and on changes in neurobiological factors in response to behavioral therapy aimed to reduce antisocial behavior (Chapter 4). In addition, empirical research was employed to study both the predictive value as well as changes in neurobiological factors in relation to adult offenders’ response to the Cognitieve Vaardigheden (CoVa) training, which is a cognitive skills training program (see Chapters 3 and 5). Finally, Chapter 6 was written as an intermezzo to reflect on how basic neurobiological measures, like those used in our empirical research, could be incorporated in criminological research.

In the following section, the recruitment process and methodology of the empirical study are described in more detail.

**Data collection**

Figure 1 shows the recruitment process and attrition rates of both the intervention group (i.e., participants who started CoVa training during our study) as well as the control group (i.e., wait-list control group participants).

**Recruitment process and attrition rates.** The current sample consisted of male adult prisoners all selected by Probation Service officers for the CoVa intervention program. Intervention group participants were invited for a 15-minute intake several days before the start of intervention. If prisoners showed interest to participate in our study, an appointment for pre-test was scheduled. Attrition between ‘showing interest’
and pre-test assessment was mainly due to ‘no-show’ without a reason, sudden loss of interest, or external circumstances (e.g., detainee was not correctly informed about the scheduled assessment). In total, 47 prisoners dropped out of the research after pre-test completion. For 35 prisoners, a post-test assessment was not scheduled because they resigned from intervention. There was no significant difference in age and intelligence level between those who dropped out and those who completed treatment. The remaining 12 prisoners did not complete post-test assessment mainly because they lost interest in participation. Again, there were no significant differences in age and intelligence level between those who completed post-test assessment and those who did not.

Control group participants were recruited in a less structured manner since control group participants were only placed on the waiting-list if an intervention group had just started. However, prisoners could also partake as control group participants if there were ongoing practical issues with arranging the treatment set-up (e.g., no location available, lack of sufficient trainers). For this reason, prison officers who were aware of these practical issues and inclusion criteria for control group participation (i.e., selected for CoVa training, no history of CoVa training, and no CoVa participation within the next two months) were asked to scrutinize file records to find and invite potential control group participants. Reasons for attrition before pre-test phase were ‘no-show’ or practical reasons (e.g., other activities were scheduled). Of the 69 participants, 10 prisoners could not complete post-test assessment because they did not ‘complete’ the waitlist time due to various reasons, such as provisional release from prison or unforeseen CoVa participation. In addition, six prisoners did not complete post-test assessment due to loss of interest. Overall, no significant differences in age and intelligence level were detected between those who completed post-test assessment and those who did not.

**Materials and design.** In the current study, different measurements are employed, including self-report questionnaires, neurocognitive tasks, a heart rate assessment and behavioral evaluations. During intake, prisoners in the intervention group were provided with several self-report questionnaires regarding reactive/proactive aggressive behavior (Reactive Proactive Questionnaire), psychopathic traits (Triarchic Psychopathy Measure; TriPM), youth trauma experiences (Childhood Trauma Questionnaire), social and moral reasoning skills (Socio-Moral Reflection Measure – Short Form), and treatment motivation (Treatment Motivation Questionnaire). Prison officers approached control group participants to complete the TriPM questionnaire, followed by four questionnaires selected by the Probation Service on cognitive deficits. The intervention group had already completed these Probation Service questionnaires before taking part in the study,
Recruitment process and attrition rates.

Research design.
as they are part of the Probation Service’s intervention evaluation process. It was decided to provide these questionnaires to control group participants in order to compare both groups on pre- and post-test self-reported cognitive deficits. After the data collection was completed, it appeared that a large number of questionnaires were incomplete or missing. Unfortunately, this made the Probation Service questionnaires inadequate for our study.

Figure 2 displays the study design for both research samples. At pre-test, ‘basic’ neurobiological measurements, including neurocognitive tasks and heart rate activity registration were employed. Neurocognitive tasks were selected based on the following sources: relevant literature on the relationship between neuropsychological deficits and antisocial behavior problems (Brower & Price, 2001; Morgan & Lilienfeld, 2000; Ogilvie et al., 2011); comparable studies included in our literature reviews (e.g., Fishbein et al., 2009; Mullin & Simpson, 2007); and domains of cognitive functioning central to the CoVa training program (including planning, perspective taking, inhibition and social/moral reasoning/thinking). The following neurocognitive tasks were employed: the Stroop Color Word Task, the D2 Cancellation Task, the Wechsler Adult Intelligence Scale-III-Digit Span test, the Modified Wisconsin Card Sorting Task, the Tower of Hanoi, the Stop it Task, the Reading the Mind in the Eyes Task, and the Controlled Oral Word Association Task. In addition, a verbal intelligence test was completed (Nederlandse Leestest voor Volwassenen, NLV). Furthermore, one of the most robust biological correlate of antisocial behavior is low resting heart rate (for meta-analyses see Lorber, 2004; Ortiz & Raine, 2004; Portnoy & Farrington, 2015). For this reason, heart rate activity was assessed in the current study and measured with the VU-AMS ambulatory monitoring system (VU University, Amsterdam; De Geus, Willemsen, Klaver, & Van Doornen, 1995; Willemsen, De Geus, Klaver, Van Doornen, & Carroll, 1996). Resting heart rate and heart rate variability were assessed during a 5-minute baseline period. In addition, the D2 Cancellation Task was used as a cognitive stressor to investigate heart rate activity during stressful phase.

The first behavioral evaluation was completed by prison officers (using the Social Dysfunction Aggression Scale, SDAS), and for the intervention group an additional evaluation was completed by trainers using the Treatment Gain: Short Scale questionnaire. Prison officers and trainers also evaluated prisoners’ behavior at the second behavioral evaluation moment. All measures completed at pre-test were assessed again at post-test, except for the verbal intelligence test. In addition, participants in the intervention group completed a three-item questionnaire to assess self-reported treatment gain. File record information was derived from different sources. Background information regarding age, index offence, age of first judicial contact, recidivism risk, and cognitive deficits was derived from Probation Service files. In addition, the Custodial Institutions Agency
(in Dutch, ‘Dienst Justitiële Inrichtingen’) of the Ministry of Security and Justice provided information on the total number of previous imprisonments.

Overall, the empirical study adds to existing literature in several ways: 1) previous empirical studies on the relationship between neurobiological factors and treatment outcome of individuals with antisocial behavior generally focused on child and adolescent samples, while the current study focuses on adult prisoners; 2) both the predictive value as well as the plasticity of neurobiological factors in response to treatment are investigated within one sample; and 3) conducting research with prison samples is often complicated resulting in varying sample sizes. Comparable studies were able to include 42 (Mullin & Simpson, 2007), 119 (Ross, 2012), and 224 (Fishbein et al., 2009) prisoners. The current study includes 190 prisoners, which is a relatively large sample size for this particular field of research.

**Organization of the dissertation**
The structure of the dissertation, including problem statements, research questions and employed methods, is shown in Table 1.

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<th>Problem statement</th>
<th>Research question</th>
<th>Approach</th>
<th>Chapter</th>
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</thead>
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<tr>
<td>What is the predictive value of neurobiological factors in relation to the outcome of a cognitive skills program for adult prisoners?</td>
<td>What previous research has been conducted that has investigated the predictive value of neurobiological factors in relation to treatment outcome of individuals with antisocial behavior?</td>
<td>Literature review</td>
<td>2</td>
</tr>
<tr>
<td>Are neurocognitive skills and heart rate activity predictive of male adult prisoners’ response to a cognitive skills training program?</td>
<td></td>
<td>Empirical research</td>
<td>3</td>
</tr>
<tr>
<td>Do prisoners’ neurobiological factors change in response to a cognitive skills training program?</td>
<td>What previous research has been conducted that has investigated the change in neurobiological factors after treatment for individuals with antisocial behavior?</td>
<td>Literature review</td>
<td>4</td>
</tr>
<tr>
<td>Does neurocognitive functioning and heart rate activity change in male adult prisoners following treatment and is this related to behavioral improvement?</td>
<td></td>
<td>Empirical research</td>
<td>5</td>
</tr>
<tr>
<td>In what way could neurobiological knowledge contribute to the field of criminology?</td>
<td>How can ‘basic’ neurobiological measurements benefit criminological research and practice?</td>
<td>State of the Art review</td>
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In Chapter 2, results of a literature review on the predictive value of neurobiological factors in relation to treatment outcome among individuals with various types of antisocial behavior are presented. Additionally, empirical research on the predictive value of neurobiological factors is described in Chapter 3. In this empirical research, the neurobiological characteristics of the intervention group are examined and related to various treatment outcome measurements. Chapter 4 presents another literature review, which includes previous research that investigated changes in neurobiological factors in response to behavioral therapy for individuals with antisocial behavior. Chapter 5 explores changes in neurocognitive functions and heart rate activity in both the intervention group and in the control group. In addition, the relationship between neurobiological changes and behavioral improvement in response to cognitive therapy is investigated. The aim of Chapter 6 is to reflect on how ‘basic’ neurobiological measures, as used in our empirical research, could be of value for the field of criminology in general. Finally, Chapter 7 proposes a heuristic model on the relationship between neurobiological factors and correctional rehabilitation. In addition, results from the literature reviews and our empirical study are summarized and discussed with regard to the heuristic model. The discussion section also reflects on limitations of the current study, and discusses broader implications for clinical practice and future research.
References


Buysse, W., & Loef, L. (2012). Effectiveness of the cognitive skills treatment (CoVa) for offenders. Amsterdam: DSP-groep.


