Chapter 7
Summary and General Discussion
BACKGROUND

The literature addressed in this thesis clearly demonstrates that the prison population consists, for a large part, of people with executive dysfunction, people suffering from psychiatric and neurodevelopmental disorders, and people with intellectual disabilities.1-3 These factors may all contribute to profound externalizing psychopathology, including antisocial and aggressive behavior. In addition, these factors may complicate the ability to manage activities of daily life, such as finding and keeping housing and employment, or maintaining stable relationships, which are all risk factors for reoffending. In sum, these factors could indirectly increase the risk of criminal conduct by contributing to impaired executive functions and self-regulation.4 Self-regulation is largely coordinated by the prefrontal cortex, through top-down and bottom-up inhibition.4-6 Indeed, individuals with impaired self-regulation, such as antisocial and violent offenders, show reduced function and volume in prefrontal regions such as the orbital and dorsolateral prefrontal cortex and the anterior cingulate cortex.7

The prison environment is considered to be an impoverished environment due to the inherent loss of autonomy and physical activity following imprisonment. This impoverished environment may negatively influence prefrontal functioning and reduce self-regulation.8-10 In addition, the prison environment may induce chronic stress in prisoners, for example, due to constant feelings of unsafety or a loss of autonomy. Chronic stress increases activity in the amygdala and subcortical regions, which subsequently weakens prefrontal functioning.11 Imprisonment is also known to cause sleep disturbances, which is one of the most commonly reported complaints at the prison medical services. Disturbed sleep may also reduce prefrontal functioning and can be considered a risk factor for aggressive and violent behavior.12-16

The main objective of this thesis was to study the influence of the prison environment on self-control and executive functions. In addition, we aimed to study executive functions within the prison population, and more specifically between different violent and non-violent subgroups of offenders.

OVERVIEW OF THE MAIN FINDINGS

In chapter 2, we provided a review of studies addressing executive functions in the general prison population.17 Remarkably, we found very few controlled studies
that were conducted in regular prisoners, and the studies included in the review were often characterized by a small sample size and a limited neuropsychological test battery. Nevertheless, several studies report deficits in attention and set-shifting in the general prison population. In addition, impaired set-shifting and working memory in violent subgroups were also reported, while impaired inhibition, working memory, and problem solving were found in non-violent subgroups.

Differences in executive functioning between violent and non-violent offenders in a relatively large sample size of offenders were studied in chapter 3.\textsuperscript{18} We observed that violent offenders demonstrated a significantly worse response inhibition compared to the non-violent offenders. Other functions that were tested, such as attention, planning, set-shifting, working memory, and impulsivity/reward sensitivity, did not significantly differ between violent and non-violent offenders. Furthermore, explorative analyses on the whole group showed a relation between planning abilities and the number of previous convictions. Prisoners with poor planning abilities had been detained more often than prisoners with superior planning abilities.

Disturbed sleep is a common complaint among prisoners, and may be a result of the impoverished and stressful prison environment. Disturbed sleep is also related to reduced self-control and, subsequently, increased aggressive behavior. As described in chapter 4,\textsuperscript{19} sleep-wake disturbances, as well as aggressive behavior, are often found in prisoners in the Penitentiary Psychiatric Center (a psychiatric center inside prison), where we studied the relationship between the sleep-wake rhythm and aggression in prisoners with a psychotic illness. We found a significant relationship between aggression and nocturnal restlessness, as increased nighttime activity was associated with an increase in agitated or aggressive behavior.

While reduced self-control and executive functions are characteristic of antisocial and criminal populations,\textsuperscript{1,7} the influence of imprisonment on these characteristics has rarely been examined. Therefore, we studied change in self-control and executive functions following imprisonment in chapter 5.\textsuperscript{20} We administered an extensive neuropsychological test battery within one week of the participant's arrival in prison. After three months of imprisonment, we retested our participants and found a decline in bottom-up self-control, while top-down
self-control (response inhibition) remained constant.

Interventions aimed at improving self-control in prisoners have already been implemented in several prisons. Running therapy is one example of such an intervention, though most patients are referred to this therapy for other reasons (e.g. depression). By gradually and systematically increasing the level of physical activity of the participants, both direct and indirect effects may positively influence self-control. Conducting a randomized controlled trial would entail withholding such treatment, for example, by placing patients on a waiting list for three months, while the intervention is already part of the health care program of the prisons that offer Running therapy. Therefore, in our study protocol in chapter 6, we extensively described how such an intervention could initially be studied as a Phase I/II pilot, of which the results may lead to sufficient arguments to subsequently conduct an RCT.

LIMITATIONS

Before turning to implications resulting from this thesis, some limitations to our studies should be mentioned. An important limitation to the studies conducted in the Penitentiary Institution in Amsterdam is the absence of a control group, which would have enabled us to establish if, and to what extent, our population actually suffers from executive dysfunction. A control group in our longitudinal study (chapter 5) would also have enabled us to give a more accurate effect size of the observed decline in inhibition, since an improvement on neuropsychological tasks is generally expected due to practice effects. In addition, it would have enabled us to analyze whether the improvement we found on planning was significant compared to healthy non-imprisoned controls.

Another limitation of the longitudinal study was the small sample size caused by a large number of dropout. While 130 prisoners were tested at baseline, only 37 were retested after three months, as many of the prisoners tested at baseline left prison within three months. A large proportion of this dropout was most probably selective: those suspected of less serious crimes are released earlier and more often than those suspected of more serious crimes. Although this selective dropout may reduce the validity of our findings on the one hand, it may also be argued that our findings need not be generalized to this specific subgroup, as they are less likely to spend three months in prison. Despite the small sample size, sufficient power
was reached. A larger sample size would have allowed us to analyze potential differences between subgroups, such as violent and non-violent offenders. The small sample size is mainly due to the decision to conduct our study in a remand prison, where prisoners stay for an average of three months, and where a major subgroup leaves prison after two weeks (after two weeks a court decides whether or not a remand prisoner will be held in custody under a different legal status for a prolonged period). The small sample size was also a limitation of our study on disturbed sleep in prisoners with a psychotic illness (chapter 4). This was mainly caused by difficulties with recruitment, as patients were asked to wear a device for seven consecutive days that monitors their sleep-wake rhythm.

Another factor that could be considered as a limitation is the methods used to measure inhibition. Inhibition is actually a broad neuropsychological construct that can be subdivided into a number of elements, such as response inhibition, deferred gratification, and reversal learning (which, in turn, can be broken down further into multiple components). At face value, one can imagine that an impulsive violent offender may have a deficit in response inhibition, i.e. difficulties withholding an aggressive response, while an offender committing a violent robbery in order to obtain valuable items may have a deficit in deferred gratification, i.e. difficulties in resisting a potentially high reward. Studying inhibition on such a level, however, requires a large sample size, which is challenging to accomplish in the prison environment.

We continue our reflection on these limitations, as well as on the limitations inherent to studies conducted in a prison environment, in the paragraph on recommendations for future studies.

**IMPLICATIONS AND RECOMMENDATIONS FOR PRISON PRACTICE AND POLICY**

The results of the second chapter of this thesis suggest that the general prison population may suffer from specific deficits in executive functions, such as attention, set-shifting, working memory, and inhibition, while the third chapter reveals differences in inhibition between different subgroups of prisoners. Even though the findings in the second chapter are based on a limited number of studies, they are in line with findings in antisocial and criminal populations, and, in our opinion, call for increased attention for neuropsychological impairments in
prisoners. The lack of neuropsychological studies in regular prisons as described in our review may well be a reflection of the lacking presence of neuropsychologists in prison, and a reflection of limited knowledge of neuropathology in other medical and paramedical disciplines. As a result, neuropsychological impairments resulting from dementia, Korsakoff, fetal alcohol spectrum disorders, or traumatic brain injury may go unnoticed – or be misclassified – in prison. Prisons should consider training their health care professionals (i.e. nurses, psychologists, and psychiatrists) to understand that symptoms such as impulsivity may stem from a neurobiological cause, or that a person who repeatedly asks the same questions may suffer from memory impairment. In addition, increased expertise in neuropsychology may also imply the recognition of the relationship between disturbed sleep and behavioral problems such as agitation and aggression, as described in chapter four. Since disturbed sleep is one of the most common complaints at the prison medical services, prison staff should also be alert to sleep disturbances in prisoners displaying aggressive behavior. Sleep may improve by increased exposure to daylight and increased physical activity. The question arises whether prisoners with sleep disturbances are actively encouraged and supported by the prison staff to undertake these steps in order to improve their sleep.

Another implication of this thesis is the negative influence imprisonment may have on self-control (chapter 5). Even though our study was small, our results are in line with the results from decades of experimental animal studies, as well as numerous human studies, on the influence of an impoverished environment on the brain. Interestingly, several large international studies have also shown that harsher prison environments (i.e. more impoverished environments) do not deter or prevent reoffending, and may even be more likely to increase reoffending. While future studies are needed to demonstrate the exact influence of the prison environment on various aspects of self-control and executive functions, prison policy may be adjusted in advance, since an extensive body of literature has shown the positive influence of environmental enrichment on self-regulation and executive functions. Since these functions are known to be impaired in many prisoners and are possibly related to reoffending, it is worthwhile to improve these functions in the prison population. Examples of enrichment could be simple things like regularly reading books, or more challenging enrichment such as
education, or increased possibilities to do meaningful and cognitively challenging labor – all preferably in a research setting. A large part of the daily activities in Dutch prisons consists of labor. When labor in prison closely resembles regular work, prisoners are not just provided with work at their own level (providing cognitive stimulation), but also get the opportunity to adjust to a regular life with normal work weeks, i.e. they can start living in prison the way we expect them to live outside, after they have served their sentence.

While prison policy may be changed to enhance physical activity, cognitive stimulation, and social interaction in the long term, prison staff can start to pay more attention to sedentary behavior and a lack of the other two factors of enrichment. Prison staff may, for example, be able to motivate prisoners to increase their physical activity or challenge them to solve everyday problems within the prison. In the Netherlands, a number of initiatives that may be considered an enrichment to the prison environment can already be identified. For example, one program based on the work of prof. dr. Miranda Boone aims to reduce the harmful influence of imprisonment wherever possible by analyzing and improving the ‘living climate’ (Dutch: thema ‘leefklimaat’) in the penitentiary institutions. Main targets of the program are 1) improving the relationships between prisoners and staff, 2) enhancing the degree of prisoner autonomy, 3) intensifying interaction with the social network outside of prison, 4) increasing safety, and 5) extending meaningful daily activities and improving prisoner health. Another theme within Dutch prisons is the focus on self-supporting capacities and autonomous functioning of the prisoners (Dutch: thema ‘zelfredzaamheid’). Prisoners are encouraged and facilitated to take care of their own business as much as possible, for example, by providing them with a key to their own cell. There is also increased attention for the “craftsmanship” of the prison staff. While staff training has always been – and will always be – focused largely on security, the prison staff will receive more training to increase their agogic skills, such as communicating effectively and building proper relationships with prisoners. Another potentially enriching, though small-scale, initiative that deserves mentioning is Running therapy, offered in PI Ter Apel by Running Therapist John Fokkink for indications such as depression, ADHD, anxiety, and sleep disturbances. This therapy may be considered an enrichment to the prison environment by increasing physical activity, which, as described in chapter six, is presumed to have a beneficial
influence on self-control. Whether all aforementioned programs will truly lead to measurable improved prefrontal functioning and self-regulation remains to be determined in future studies.

RECOMMENDATIONS FOR FUTURE STUDIES

Even though the findings of this thesis all point in the same direction, further research is required to substantiate the main hypothesis and to clarify possible mechanisms underlying our results. We recommend replication of our longitudinal study with a larger sample size. Meanwhile, it should be acknowledged that research in the prison environment is challenging, and it may be difficult to recruit a large number of participants. Note that all studies that we reviewed in Chapter 2 consisted of small groups. We also acknowledge the option to conduct a longitudinal study amongst convicted offenders, rather than remand prisoners. Recruiting new remand inmates for a longitudinal study, however, does have some specific advantages. For example, new inmates have only spent a few days in prison and have thus not yet been fully exposed to the hypothesized negative influence of the prison environment. In addition, it provides the possibility to distinguish prisoners entering prison with pre-existing executive function deficits – or other neuropsychological impairments – from those without such deficits. Moreover, the hypothesized cognitive decline may not be a linear one. It could also be most prominent in the first months of imprisonment, in which case recruiting new inmates may be crucial to reveal the hypothesized cognitive decline. Another advantage is that recruiting new inmates creates a more diverse group with respect to the types of crimes that have been committed, as suspects of, for example, petty theft are not likely to spend years in prison. Disentangling subgroups of prisoners may lead to more specific insight into whether some subgroups are more sensitive to environmental impoverishment than others. A disadvantage, however, is the large dropout rate, which is related to the time between the first and second measurement. Another disadvantage is that new inmates may experience a high level of stress in the first few days of their imprisonment, due to their new environment, which may temporarily cause reduced performance on cognitive tests. Researchers should take the effect of stress into consideration, for example, by measuring stress through a questionnaire or interview. Recruiting convicted offenders for a longitudinal study also has some specific advantages.
First, it provides the possibility to use a much wider time window between the two moments of measurements, without causing significant dropout. One could choose to include prisoners that have a sentence that is equal to, or longer than, the prespecified time between the two moments of measurement. A wider time window would be especially useful when smaller time windows do not provide convincing results of cognitive decline. Longer exposure to the environment may result in a larger decline, which would be easier to detect statistically. A clear disadvantage of studying convicted offenders is that they may have already spent a significant amount of time in prison, and that the largest cognitive decline may have already taken place. Either way, we also recommend recruiting a control group, to compare baseline cognitive functioning of prisoners to a healthy control group, and to control for test-retest effects, which dramatically increases the statistical robustness of the analyses. Besides replicating this test-retest design, researchers should consider retesting prisoners more than once, for example after three and after twelve months of imprisonment, and perhaps even retesting prisoners after their return to society, to study both the change in cognitive functioning during imprisonment, as well as whether the potential decline is reversible.

Another recommendation is to prospectively study whether neuropsychological functioning predicts the risk of reoffending after release. Current studies regarding criminal recidivism and executive functions, including our finding in Chapter 3 regarding the relationship between planning and reoffending, are retrospective; reduced executive functioning is related to an increased incidence of imprisonment in the past. Considering that imprisonment may negatively affect executive functions, and may thus (partly) explain this relationship, retrospective findings regarding reduced executive functioning and criminal recidivism can only be considered to be hypothesis generating.

With respect to the initiatives aimed at enhancing the prison climate in the Netherlands (as mentioned in the previous paragraph), we would like to recommend to quantitatively study the effects of such initiatives, preferably in the form of a randomized controlled trial – provided that this is allowed under legislation regarding scientific research with humans – with executive functions and self-control as primary outcome measures.

Based on the experience that we have gained by doing research in a prison environment during the past years, we would also like to give some practical
recommendations regarding research in prison. Researchers should anticipate various operational issues during the data collection phase of their studies. The prison environment is focused on safety, protocols, and adherence to the daily schedule, and data collection may interfere with these aspects. For example, researchers may visit the wards themselves to recruit participants, as we have done in our studies. However, researchers may need the assistance of the prison staff, for example, to open cell doors or answer questions regarding a suitable time and place to administer the test battery. This places a significant burden on a discipline that is already burdened with a high workload. We recommend researchers to carefully study the daily programs of all wards and become familiar with the procedures and protocols, in order to reduce the burden placed on the prison staff, and in order to be able to plan testing sessions independently. Researchers should aim to actively invest in a positive working alliance with the prison staff and minimize interference with their daily operations. Such a positive working alliance is also important for the safety of the researchers and prisoners. The researchers should be able to consult the prison staff consistently on whether a potential participant is considered safe to approach. Furthermore, unexpected events may occur in prison, leading to sudden changes in the daily program of an individual prisoner. For example, lawyers may visit their clients unannounced, calamities or fire drills may require all prisoners to return to their cells, or prisoners may even be transferred to another facility or be released at any given time. Researchers will not be able to anticipate on such events, and will simply need to cease testing upon occurrence of such events.

**CONCLUSION**

This thesis substantiates the call for increased attention – from scientists, national and local policymakers, and prison staff – for the neuropsychological functioning and impairments of the prison population, as well as the potential influence of an impoverished environment and a sedentary lifestyle on self-control and executive functions. A preliminary message from the studies presented in this thesis may best be summarized as: do not restrain the prisoner’s brain.
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