



Neuroscientific and behavioral genetic information in criminal cases in the Netherlands

C.H. de Kogel^{*†} and E.J.M.C. Westgeest[‡]

Research and Documentation Centre (WODC) of the Ministry of Security and Justice, the Hague, the Netherlands

^{*}Corresponding author. E-mail: c.h.de.kogel@minvenj.nl

ABSTRACT

In this contribution an empirical approach is used to gain more insight into the relationship between neuroscience and criminal law. The focus is on case law in the Netherlands. Neuroscientific information and techniques have found their way into the courts of the Netherlands. Furthermore, following an Italian case in which a mentally ill offender received a penalty reduction in part because of a 'genetic vulnerability for impulsive aggression', the expectation was expressed that such 'genetic defenses' would appear in the Netherlands too. To assess how neuroscientific and behavioral genetic information are used in criminal justice practice in the Netherlands, we systematically collect Dutch criminal cases in which neuroscientific or behavioral genetic information is introduced. Data and case law examples are presented and discussed. Although cases are diverse, several themes appear, such as prefrontal brain damage in relation to criminal responsibility and recidivism risk, and divergent views of the implications of neurobiological knowledge about addiction for judging criminal responsibility. Whereas in the international 'neurolaw literature' the emphasis is often on imaging

[†]C.H. (Katy) de Kogel, Ph.D, is a senior researcher at the Research and Documentation Centre (WODC) of the Ministry of Security and Justice the Netherlands. She is a psychologist and holds a PhD in behavioral biology. She is a project leader within the research program Brain & Cognition: Societal Impact in Health, Education and Social Safety of the Netherlands Organisation for Scientific Research (NWO), grant: 056-21-010, which partly contributed to the work reported in this paper. She is also a member of the Steering Committee of the European Association for Neuroscience and Law, founded in Jan. 2013 in Milano, Italy.

[‡]E.J.M.C. (Lizanne) Westgeest, MA LL.M, is a junior researcher at the Research and Documentation Centre (WODC) of the Ministry of Security and Justice. She graduated in clinical child and adolescent studies and in criminal law.

techniques, the Dutch findings also illustrate the role of neuropsychological methods in criminal cases. Finally, there appears to be a clear need of practice oriented instruments and guidelines.

KEYWORDS: neurolaw, criminal law, neuroscience, behavioral genetics

INTRODUCTION

In 2012, the Court of Appeal of Leeuwarden, the Netherlands dealt with the case of S.H.¹, a young woman who is accused of suffocating her four newborn children, during or shortly after birth by covering their nose and mouth and/or throat with a pillow. Subsequently, she would have put the babies in litterbags which she left in a suitcase in the attic of her parents' house. Initially, explanations were mainly sought on a social level. A first instance court presumed that she took the decision to kill the children out of fear of discovery of her pregnancies. The first instance court imposed a prison sentence of 12 years because of infanticide: three times murder and once manslaughter of the four newborn children. When the case is with the Court of Appeal, the defendant agrees, after having refused this until then, to be examined by a psychiatrist, a psychologist and a behavioral neurologist. In the decision, the Court of Appeal quotes part of the conclusions of the experts which add a neurobiological perspective to the case:

thereby it is established that the defendant has a personality disorder which is associated with or is (co)-determined by cerebral organic damage in the sense of a frontal syndrome and that this disorder has restricted her to a considerable extent, compared to a healthy person, in overseeing the problems which she faced and in making choices to solve these problems.²

As a result of this disorder, the experts believe that the accountability of the defendant for the crimes is substantially reduced. In addition, they say that to prevent criminal recidivism, prolonged treatment and counseling is needed. Taking into account these expert reports, the Court of Appeal, in contrast to the first instance court, finds that it cannot be proven that the accused had already decided to kill the children before the births. The Court of Appeal sentences S.H. for four times manslaughter with a TBS order with mandatory hospitalization and a prison sentence of three years. The TBS order ('Terbeschikkingstelling', 'Entrustment' order, art 37a Criminal Code) can be imposed upon mentally disordered adult offenders who are considered not responsible or of diminished responsibility for their offense(s), and who are perceived as a severe danger to others or society.

This case illustrates how the information of the experts, about damage to the frontal brain and its presumed cognitive and behavioral consequences, is used by the court to help answer the judicial question of accountability and to determine a sentence.

Researchers in the USA report already for some time about the use of neuroscientific information in criminal justice practice.³ The number of criminal cases in the database

¹ Court of Appeal Leeuwarden 11 Oct. 2012, ECLI:NL:GHLEE:2012:BX9891.

² Free translation of a fragment of the text from the verdict.

³ NITA A. FARAHANY (ED.), *THE IMPACT OF BEHAVIORAL SCIENCES ON CRIMINAL LAW* (2009).

Westlaw in which the judge mentions neuroscientific evidence in his or her opinion has allegedly increased from 112 in 2007 to more than 1500 in 2011.^{4,5}

Neuroscientific information and techniques have found their way into the courts of the Netherlands as well.⁶ Furthermore, following a penalty reduction for a mentally ill offender in an Italian case because of a ‘genetic vulnerability for impulsive aggression’, the expectation was expressed that such ‘genetic defenses’ will sooner or later appear in the Netherlands too.⁷

To gain more insight in the ways neuroscientific and behavioral genetic information are used in criminal justice practice in the Netherlands, WODC systematically collects Dutch criminal cases in which neuroscientific or behavioral genetic information is introduced. In this paper, some of the first results of this database project are presented.

We describe types of criminal cases (eg types of offenses, expert assessments, and penalties), and subsequently explore for which judicial questions neuroscientific information is sought, and whether it is used in a mitigating or aggravating way. For each judicial question, one or two examples of cases are briefly presented and discussed. Although the cases are diverse, several themes appear. Two prominent ones are pre-frontal brain damage in relation to criminal responsibility and recidivism risk, and diverging views of the implications of the growing knowledge about neurocognitive deficits in addiction for judging criminal responsibility. The cases also illustrate the role of neuropsychological methods in criminal cases, whereas in contrast in the ‘neurolaw literature’ the emphasis is often on imaging techniques. It is concluded that there is a clear need of practice oriented instruments and guidelines.

First however, the methods used for finding, selecting, and analysing the case law are described. Furthermore, in the Appendix, we give background information about numbers of criminal cases and publication practice with respect to case law in the Netherlands, and its consequences for the quantity and quality of the case law data used in this paper.

SEARCHING AND SELECTING CRIMINAL CASES IN WHICH NEUROSCIENTIFIC OR BEHAVIORAL GENETIC INFORMATION IS INTRODUCED

Decisions in criminal cases published in the years 2000–12 were searched in the Dutch case law database of ‘*Rechtspraak.nl*’. This database is operational since 2000 and has been progressively filled each year since then. In the Netherlands however only a small proportion of the total number of criminal cases that come before the courts each year are published, and this is not necessarily a representative set of the total number of cases (see Appendix for more details on this matter). This means that, although we analysed all available published cases in the Netherlands in which neuroscientific or behavioral

⁴ Nita A. Farahany, *Me, Myself, and My Brain*, ANNUAL MEETING INTERNATIONAL NEUROETHICS SOCIETY, Oct. 11–12, 2012, <http://vimeopro.com/vcube/neuroethicssociety> (accessed Oct. 8, 2013).

⁵ A limitation is that Westlaw contains but a small number of American case law. Only appeal cases are included, and of these only a fraction. It is therefore unknown if and in how many other cases neuroscientific information is introduced. Furthermore criteria for inclusion of a case in Westlaw appear to be unclear (Farahany, *supra* note 4).

⁶ Laura Klaming & Bert-Jaap Koops, *Neuroscientific Evidence and Criminal Responsibility in the Netherlands*, in INTERNATIONAL NEUROLAW: A COMPARATIVE ANALYSIS 227, 256 (Tade M. Spranger ed., 2012).

⁷ Gerard P.M.F. Mols, *Genenkorting (Gene discount)*, 7 STRAFBLAD, 513, 514 (2009).

genetic information is introduced, which is a valuable source of qualitative information, we cannot draw general, quantitative conclusions on the basis of our dataset about how neuroscientific information is used in Dutch courts. This is because we do not know how many unpublished cases there are that would fit our selection criteria, or whether our dataset is representative of the total number of criminal cases in which neuroscientific or behavioral genetic information is introduced.

The search string consisted of the Dutch terms ‘genetis*’, ‘neuro*’, ‘hersens*’, ‘erfelijk*’, ‘hoofdletsel’, ‘mri’, ‘ct-scan’, ‘pet-scan’, ‘electro-encephalogra*’, ‘serotonine’, and ‘MAOA’⁸.

From the cases found (Table 1), those were selected in which neuroscientific or genetic information is introduced with respect to the suspect/defendant, and (1) neuroscientific or (2) genetic information is raised in relation to (a) behavior (eg aggression, violence, addiction), (b) brain function (eg memory, perception, cognition, self-control), or (c) mental state (eg consciousness, automatism, psychosis).⁹

Considered as neuroscientific information is information from (1) assessment of the brain with imaging techniques (such as MRI, SPECT, PET) or EEG, neuro-endocrinological assessment (eg hormones, neuropeptides), (2) neuropsychological assessment, or (3) referring to a certain neurobiological predisposition or damage of the brain.

Considered as behavioral genetic information is information from (1) heritability assessment, eg assessment of specific genes or (2) referring to a ‘genetic predisposition’ or a family history that seems to indicate a biological origin of a particular behavior.

It was coded to what extent the neuroscientific or genetic information affected the decision of the court about criminal responsibility of the defendant. The alternatives used were ‘yes’, the neuroscientific or genetic information was decisive (for instance the court mentions neuroscientific information as a basis for acquittal or no accountability for the offense); ‘partly’, the neuroscientific or genetic information affected the decision partly (for instance neuroscientific information is mentioned by the court as a basis for the decision together with other factors such as a psychiatric interview that reveals a personality disorder); ‘no’, the neuroscientific or genetic information did not affect the decision (for instance there was a neurobiological problem but this was not treated by the court as relevant for the decision about accountability for the offense); ‘not applicable’, for cases where the question of criminal accountability is not central (for instance in some of the Supreme Court cases that focus on a judgment of the work of the Court of Appeal).

Information about the subjects mentioned above was extracted from each case using a scoring instruction. In order to ensure consistency of scoring, cases were scored double. Two investigators scored each case independent of each other. When scores differed from each other, these were discussed and consensus was sought.

⁸ The Dutch search terms are based on the search terms in American research (Farahany, *supra* note 4). Because the terms will be used in research to compare the use of neuroscientific information in criminal cases in different countries, the terms were translated into Dutch, keeping as close to the original meaning as possible. The terms listed would correspond to the following English versions: ‘genet*’, ‘neuro*’, ‘brain*’, ‘heritab*’, ‘head injury’, ‘mri’, ‘ct-scan’, ‘pet-scan’, ‘electro-encephalogra*’, ‘serotonin’, and ‘MAOA’.

⁹ The criteria for the inclusion of cases were developed within the European Association of Neuroscience and Law. These will be used in comparative research involving different countries.

Table 1. Searching and selecting criminal cases in which neuroscientific or behavioral genetic information is introduced.

Year	Total no. of criminal cases per year published on <i>Rechtspraak.nl</i> ^a	Criminal cases found with 'neuro-search terms' (genetis* or neuro* or hersen* or erfelijk* or hoofdletsel or serotonine or MAOA)	Criminal cases found with 'technique search terms' (mri or ct-scan or pet-scan or electro-encephalogra*)	Criminal cases selected for 'neurolaw database' ^b
2000	664	12	0	1
2001	1129	33	1	2
2002	1371	37	3	3
2003	1546	54	1	2
2004	1730	68	0	8
2005	1877	80	2	14
2006	2666	107	9	10
2007	3202	136	8	23
2008	4042	205	8	19
2009	5030	261	15	27
2010	5593	273	16	27
2011	6480	288	10	38
2012	5963	295	24	57

^a(accessed Aug. 25, 2014). The total number of criminal cases published on *Rechtspraak.nl* contains both crimes ('misdrijven') and less serious offenses ('overtredingen'), although in practice mostly the more serious and complex cases are published (see text for criteria for publication in *Rechtspraak.nl*). Furthermore this total number of criminal and offense cases contains not only first instance court cases but also cases of the Courts of Appeal and of the Supreme Court of the Netherlands.

^bTwo extra cases found with other search terms: 'arousal', and 'aangeboren' ('inborn') were also included.

NUMBERS AND CHARACTERISTICS OF CASES

We found 231 criminal cases that met the selection criteria mentioned above. Neuroscientific information is the most common. It is introduced in 207 of the cases. Behavioral genetic information is involved in 14 cases, and in another 10 cases neuroscientific information as well as behavioral genetic information is involved.

Table 2. Type of offense.

<i>Type of offense (most serious offense in the case)</i>	<i>No. of cases</i>
Violent offense	104
Sexual offense	23
Stalking (art. 285b)	5
Property offense	20
Traffic offense (WvW)	22
Arson	10
Illicit drugs	2
Other offense	5

In 191 of the 231 cases one or more offenses were considered proven by the court. The remaining cases consisted of Supreme Court cases ($n = 8$), extension or termination of a TBS- or ISD-order ($n = 22$), cases in which the offense was declared not proven ($n = 5$), suspension of prosecution: ($n = 2$), or ‘other’ cases ($n = 3$, see legend of Table 3).

Of the 231 cases found, 178 were First Instance Court cases, and there were 45 Court of Appeal cases, and eight Supreme Court cases. A minority of cases (22) concerned the continuation or termination of a TBS- or an ISD-order.¹⁰ The majority of cases are ‘regular’ criminal cases.¹¹

In most of the cases found, serious offenses and long sentences are at issue, although a wide range of offenses and penalties occur (Tables 2 and 3). In the majority of cases, a prison sentence and/or a measure for high-risk offenders (TBS, ISD or PIJ¹²) is imposed.

It is understandable that neuroscientific information is mainly (but not only) introduced in cases with a serious violent or sexual offense and with severe penalties at stake, because in such cases it is likely that a report of a behavioral expert on the mental capacities of the defendant will be requested.¹³ In 175 of the cases found, two or more behavioral experts reported to the court. We found no cases in which an

¹⁰ The measure of ‘Placement in an Institution for Habitual Offenders’, (‘Maatregel Inrichting Stelselmatige Daders’, ISD, art 38m–38u Criminal Code), aims to diminish serious crime by persistent, habitual adult offenders. These are often offenders with problems due to substance dependence. The ISD-measure can be imposed by the court for a maximum of two years. ISD leads to mandatory placement in an institution for habitual offenders, and when possibilities for behavioral change and reduction of criminal recidivism are perceived, a treatment offer is made to the offender.

¹¹ In four instances, a case is included in the database as a first instance court case as well as a court of appeal case. The remainder involves unique criminal cases.

¹² The measure of ‘Placement in an Institution for Juveniles’ (‘Plaatsing in Inrichting Jeugdigen’, PIJ, art 77s Criminal Code) can be imposed by the court for three years, and can thereafter be continued by the court to a maximum of seven years. PIJ is intended for criminal juveniles with a developmental disorder or psychological/psychiatric problems. The aim of the PIJ-measure is reintegration into society by resocialization. In the Netherlands, juveniles of 12–18 years in principle fall under juvenile criminal law. Juveniles of 16 or 17 may be sentenced according to adult criminal law. Since the new ‘Adolescent Criminal Law’ came into effect, Apr. 1, 2014, adolescents of 18–23 years old may be sentenced according to juvenile criminal law.

¹³ Expert reports can be requested by the court, the prosecutor, and the defense. It is notable that the Netherlands has an inquisitorial system with professional judges and no (lay) juries. The judge actively investigates the facts of the case.

Table 3. Main outcome of the criminal case.

<i>Main outcome</i>	<i>No. of cases</i>
Acquittal ('vrijspraak')	5
Dismissal of judicial proceedings ('ontslag van alle rechtsvervolging')	6
Guilty without sentencing ('schuldigverklaring zonder strafoplegging')	2
Prison sentence	112
(Prison sentence and) TBS, PIJ, or ISD	46
Community service, learning order ('taakstraf')	14
Fine ('geldboete')	4
Denial of the authority to drive a car ('Ontzegging rijbevoegdheid')	1
Mandatory placement in a civil psychiatric hospital ('Plaatsing in psychiatrisch ziekenhuis')	6
Suspension of prosecution ('schorsing rechtsvervolging')	2
Continuation TBS or ISD	16
Termination TBS or ISD	6
Supreme Court case	8
Other ^a	3

^aThese cases concern respectively: rejection of a claim for cancellation of parole, founded statement of objection, and an interlocutory judgment.

MRI-scan was shown in court in relation to the brain and behavior of the defendant or was central in the reasoning about this. We know however that MRI-scans are often part of the interdisciplinary examination of the defendant in cases where pre-frontal damage, for instance pre-frontal dementia is suspected.¹⁴ Furthermore, it has been estimated that in assessments of suspects of serious offenses by the Netherlands Institute of Forensic Psychiatry and Psychology (NIFP), an MRI-scan is made in about half of the cases.¹⁵ Typically in the serious violent or sex offense cases we found, the neuroscientific information provided is part of a larger picture about the defendant to which experts of several disciplines contribute, usually psychiatry, (neuro) psychology, the probation service, and other disciplines such as neurology if considered necessary. Different methods are used to gain insight in the person of the defendant and his mental condition at the time of the offense depending on the case, for instance psychiatric

¹⁴ Cees Jonker et al., *Twee Verdachten Met Hersenletsel en Crimineel Gedrag. De Bijdrage van de Neuroloog aan Forensisch Psychiatrische Diagnostiek*, 53 TIJDSCHRIFT VOOR PSYCHIATRIE 181, 187 (2011), and personal communication Prof. dr Cees Jonker.

¹⁵ Informal presentation of Carla van El at NIFP, July 2013.

Table 4. Judicial questions with respect to which neuroscientific or behavioral genetic information is introduced.

<i>Judicial question</i>	<i>No. of cases</i>
Evidence for committing the offense ('bewijs')	7
Competency to stand trial ('in staat vervolging te begrijpen')	4
Intent ('opzet')	20
Guilt/negligence ('culpa')	14
Premeditation ('voorbedachte raad')	2
Accountability ('toerekenbaarheid')	72
Duress ('psychische overmacht')	4
Excessive self-defense ('noodweerexces')	4
Criminal recidivism risk ('recidiverisico')	15

A criminal case is only included with respect to a specific judicial question if in the description of the case neuroscientific information is explicitly linked to answering the same judicial question. Because this may concern more than one judicial question per case, the same case may appear more than once in Table 4. Not in all the case descriptions an explicit association can be found between the neuroscientific or behavioral genetic information introduced and the answering of one of the specific legal questions mentioned in Table 4. These latter cases concern inter alia the following. Neuroscientific information is used to describe the etiology of a disorder ($n = 15$); it is stated that further neuroscientific assessment is needed or should have been conducted ($n = 18$); no information is given in the description of the case about the results of the neuroscientific assessment mentioned (eg there is a reference to a neurological report, but without information on the content, and no information about the legal question for which the information is sought ($n = 14$)); no aberration or indication for an aberration was found in the neuroscientific assessment, *and* it is not clear from the case description for which legal question, if any, the information is used ($n = 22$); The neuroscientific assessment indicates an aberration (eg a stroke several years ago), but the aberration is not considered in relation to the criminal behavior of which the person is accused, and the information is not used with respect to any legal question in the case ($n = 4$); The neuroscientific information relates to a statement or a defense that does not lead to any further investigation or any conclusions in the case concerned ($n = 17$).

interviews, psychological and neuropsychological tests, collateral reports, and neurological investigation.

JUDICIAL QUESTIONS AND CASE EXAMPLES

Introduction

In the criminal cases found, neuroscientific or behavioral genetic information is introduced with respect to a variety of judicial questions, in fact all the main questions that have to be addressed subsequently in the Dutch criminal trial and sentencing (Table 4). Neuroscientific information is most often used for the question whether the defendant can be considered of diminished accountability for the offense (72 cases). Such cases typically concern serious violent offenses and defendants who may have a mental disorder or defective development. In 15 cases, neuroscientific information is subsequently used to help answer the question to what extent the defendant is a risk to society. The next largest categories are cases in which neuroscientific information is used in the context of the question whether the defendant intended the unlawful act (20 cases), or if the unlawful act was due to guilt/negligence of the offender (14 cases). Some of these

cases concern violence apparently committed during sleep. In other cases, a traffic accident had happened that was possibly due to a temporary loss of consciousness of the defendant. In smaller numbers of cases, neuroscientific information is brought up in relation to the question whether there is sufficient evidence to prove beyond reasonable doubt that the defendant committed the offense, whether the defendant was competent to stand trial, if the defendant was subject to duress or excessive self-defense, or whether the defendant premeditated the offense. In the following, one or more case examples for each judicial question will be presented and discussed.

Evidence of committing the crime: reliability of statements

In some cases, references to neurological symptoms are used in the context of the reliability of evidence that the defendant has committed the offense, for instance the reliability of statements. However, in several of such cases it appears that the argument is 'just mentioned' by the defendant, but is not substantiated by any further evidence. An example concerns a woman accused of attempted manslaughter of her partner whom she stabbed in the face after a quarrel between them.¹⁶ The defendant argues that she was confused during her interrogation by the police, due to a mild concussion, and that she therefore made false statements. The court finds this statement not relevant for its judgment, and argues that there was no indication that the defendant was so distraught during questioning that she was not able to make any useful statement.

Nevertheless, cases where the effect of brain damage on the reliability of statements is at issue in a more substantial way form an interesting category. In an unpublished criminal case described by Jelicic and Merckelbach, a woman in her 30s falls down the stairs after a quarrel with her boyfriend.¹⁷ The boyfriend states that he went to bed earlier than his girlfriend and woke up from the noise of her falling. The woman is brought to the hospital by ambulance. It is not clear if she lost consciousness after the fall, but during the first days in hospital she is disoriented and does not understand where she is and why. According to the authors, this and the fact that she later remembers little of her hospital period are indications of post-traumatic amnesia. Furthermore, the woman suffers from retrograde amnesia: she cannot remember events that happened shortly before she fell. After nine days, she is dismissed from hospital. Months later she complains about loss of the sense of smell, and about continuing problems with imprinting new information, although she scores in the normal range on memory tests. According to her neuropsychologists, these may be lingering signs of her brain contusion. Half a year after her hospitalization, the woman ends the relationship with her boyfriend, because it disturbs her that he keeps going out a lot with his friends and frequently comes home drunk. Three years after her fall, the woman starts to remember that she did not just fall from the stairs, but was pushed by her boyfriend. She reports this to the police, and the boyfriend is prosecuted. His lawyer asks the investigative judge to appoint an expert to investigate the plausibility that the woman can remember being pushed of the stairs by the defendant. The judge appoints a clinical psychologist. The psychologist writes that an emotional event, such as this, is likely to be remembered better than a neutral event. Furthermore, because according to the psychologist, the woman showed

¹⁶ Court of Maastricht Feb. 10, 2009, ECLI:NL:RMAA:2009: BH 6107.

¹⁷ Marco Jelicic & Harald L.G.J. Merckelbach, *De Val van de Trap. Een Casus over Hersenletsel, Terugkerende Herinneringen en het Belang van de Neuropsychologie*, 1 EXPERTISE EN RECHT 13, 16 (2011).

a relatively fast recovery, as is usual with light brain damage, the psychologist does not consider it peculiar that the memories of the event have come back.

However, the lawyer of the boyfriend asks the judge to appoint other experts to look critically at the report of the clinical psychologist.¹⁸ These contra-experts argue that according to doctor's reports about EEG abnormalities and the amnesia after the fall, the woman *did* suffer serious brain damage. They state that from a neurobiological perspective, it is unlikely that her retrograde amnesia would have fully recovered. They argue that the minutes before the fall never come back into memory. The contra-experts describe that this has to do with the way memories are stored. Information is first transferred to the hippocampus, and subsequently from the hippocampus to the brain cortex. The second step is essential for retaining memory information, and takes several minutes to complete. In the case of a blow to the head, the exchange of information between hippocampus and cortex is lost. The contra-experts state that the judge appointed another expert after them, a professor of neuropsychology, who confirmed their conclusion.

Although it remains unclear why the woman, three years after the incident, suddenly claimed the retrieval of memories of the event, this case is interesting because it illustrates the potential role of neuropsychological knowledge about the impact of different forms of brain damage on cognitive functioning for answering questions about reliability of statements of witnesses, victims, or defendants with brain damage.

Neuropsychology does not feature by far as prominently in the literature about neuroscience and law as do neuroimaging techniques. Yet, neuropsychology may be helpful to law in several ways. In the last decades, neuropsychological research for instance has indicated deficits in the so-called 'executive functions' in populations with severe (impulsive) antisocial behavior.¹⁹ Executive functions are important for self-regulation, the ability to direct one's behavior and thinking. Examples of executive functions are: the ability to focus one's attention, the capacity to control impulses and strong emotions, the ability to plan ahead and to postpone direct satisfaction in order to reach long term goals, flexibility in adapting behavior in reaction to feedback from the environment, and the functioning of short-term memory. Deficits in executive functions are associated with a less optimal development of or damage to the pre-frontal brain.²⁰ Furthermore, neuropsychologists have developed a range of tests (nowadays often computerized tasks) that are used for the assessment of brain functioning in relation to training and therapy. Neuropsychological tests also often have several norm groups to compare individual scores with to assess whether they fall in a range that may be an indication for training or treatment. On the individual level, neuropsychology may at present have more to offer than brain imaging. For instance with respect to development of the adolescent brain, neuroscientists indicate that, although their imaging research helps to show that as a group adolescent brains differ in important aspects from adult brains,

¹⁸ These contra-experts are the authors of the article about the case: Jelacic and Merckelbach (both psychologists from the Faculty of Psychology and Neuroscience of Maastricht University).

¹⁹ See eg James M. Ogilvie et al., *Neuropsychological Measures of Executive Function and Antisocial Behavior: A Meta-Analysis*, 49 *CRIMINOLOGY* 1063, 1107 (2011).

²⁰ Sharon S. Ishikawa & Adrian Raine, *Prefrontal Dysfunction Hypothesis' Prefrontal Deficits and Antisocial Behavior: A Causal Model*, in *CAUSES OF CONDUCT DISORDER AND JUVENILE DELINQUENCY* 277, 304 (B. B. Lahey et al., eds., 2003).

MRI-scans cannot be used in individual cases yet to, for instance, predict which juvenile has an increased chance of high-risk behavior on the basis of his or her brain development.²¹

Competency to stand trial

Neuroscientific information can also play a role in determining whether the defendant is competent to stand trial. In one case, a neurologist and a neuropsychologist found that the defendant had a range of neurocognitive problems arising from previous cerebral hemorrhage and infarction. This resulted in impairments in orientation, attention, language and speech, memory, executive control functions, and visual perception. The problems were perceived to interfere with the 'ability of the defendant to understand the prosecution against him'. Therefore, the prosecution was suspended.²² We found only a few cases in which neuroscientific information was introduced in relation to fitness to stand trial, and all of these concern accused persons who were mentally severely handicapped. In these cases, the neuroscientific information appears to support and further strengthen or buttress²³ the evidence about impairments already overly apparent from the person's behavior.

Intent or guilt

In several of the criminal cases found, neuroscientific information is introduced with respect to legal questions about intent or guilt. In most of these cases, to shed more light on the question whether the defendant was aware of committing the act in question. In one case, a woman is suspected of manslaughter because she allegedly shot at someone around 2:30 am during New Year's night.²⁴ The defendant says she cannot remember anything of what happened after she went to bed at 2:00 am. She claims that she apparently acted under the influence of dream visions while 'sleepwalking' and/or was in a 'dissociative state'. The defendant has been a member of a shooting club for a long time, and claims to have dreamt that she was at the shooting range, aiming at cards with vague images. Following these statements, a physiological sleep assessment is conducted. The psycho-physiologist compares the woman's case to guidelines for determining the possible role of a sleep disorder in violent behavior. He concludes that it is likely that the defendant has committed the violent act during sleep. He reports *inter alia* that during the first phase of deep sleep, the activity of the frontal cortex of the brain is greatly reduced and that this was also the case in the defendant during sleep registration. He explains:

The disconnection between the frontal cortex and other parts of the brain during deep sleep can lead to automatic behavior. In this state there is consciousness in the sense that the individual registers his environment. But because the controlling role of the frontal cortex has been 'turned off', the person is no longer aware of his own position relative to

²¹ See eg Linda Van Leijenhof, *Why Teens Take Risks: A Neurocognitive Analysis Of Developmental Changes And Individual Differences In Decision-Making Under Risk* (2010) (Doctoral Thesis Leiden University) <https://openaccess.leidenuniv.nl/handle/1887/14615>.

²² Court of Breda Sept. 26, 2006, ECL:NL:RBBRE:2006:AY8840.

²³ Owen D. Jones, *Seven Ways Neuroscience Aids Law. Neurosciences and the human person: New Perspectives on Human Activities*. Pontifical Academy Of Sciences, *SCRIPTA VARIA*, 121 (2013).

²⁴ Court of Zutphen Nov. 9, 2007, ECLI:NL:RBZUT:2007:BB7529.

that environment. At that moment one has one's own identity, one's moral framework no longer available. It can therefore not be said that someone in a situation of automatic behavior, such as sleepwalking, acts consciously.

The defendant is acquitted because the court considers it likely that she acted unconsciously, and therefore intent is not proven.

We found one more case in which the defendant appeared to have committed a violent act during sleep. That case concerns a young girl who wounds her friend who sleeps over with a knife. In both these cases, it was not proven beyond reasonable doubt that the defendant intended the act, and the defendant was acquitted. In both cases, the psycho-physiological sleep assessment that identified a specific sleep disorder played an important if not crucial role in this conclusion.

'Violence during sleep'-cases have occurred in the UK, Canada and the USA too.²⁵ There is considerable knowledge about the neurobiological mechanisms that play a role in sleepwalking disorders.²⁶ In the area of violence during sleep, researchers have worked on a protocol to offer guidelines to experts in court.²⁷ The guidelines indicate ways to diagnose different sleep disorders that may lead to acting without conscious awareness. Furthermore, the guidelines offer ways to recognize whether the behavior at the time of the unlawful act corresponded to what would be expected from a person with a sleep disorder, and how to differentiate this from simulation.

Guidelines and protocols for the use of neuroscientific information in criminal cases could serve to articulate the state of knowledge, and the ways in which neuroscientific information can and cannot be used. They may be advisable in other areas as well where, at least in the Netherlands, guidelines or protocols do not yet exist. For instance in the case of a defendant with pre-frontal brain damage, a mental disorder such as schizophrenia, addiction, or learning disabilities.

Furthermore, several authors state that a protocol could also be helpful to prevent biases in the assessments of experts.²⁸ Merckelbach and Merckelbach argue that neurobiological (eg MRI) assessments by experts in the context of a court are sensitive to the 'pathology bias' (the inclination of clinicians to see deviance because it is suggested by the context), the 'allegiance bias' (the assessments are biased in a certain direction dependent on the process party that hired the expert), and malingering (for instance the faking of test results by the defendant). Blinding of the expert to context variables (for instance about the background of the defendant) and symptom validity testing (to assess malingering) would according to them be essential components of a protocol for the use of neuroscientific evidence in court.

In another criminal case, the question is whether the defendant is guilty of a car accident.²⁹ A man caused a serious accident by driving onto the sidewalk and hitting several

²⁵ Rosalind Cartwright, *Sleepwalking Violence: A Sleep Disorder, A Legal Dilemma, And A Psychological Challenge*, 161 AM. J. PSYCHIAT. 1149, 1158 (2004); David K. Randall, *Dangerous Dreamers*, PSYCHOLOGY TODAY.COM (Jan. 2, 2013), <https://www.psychologytoday.com/articles/201212/dangerous-dreamers>.

²⁶ Francesca Siclari et al., *Violence in Sleep*, 133 BRAIN 3494, 3509 (2012).

²⁷ Mark W. Mahowald et al., *Sleep Violence—Forensic Science Implications: Polygraphic and Video Documentation*, 35 J. FORENSIC SCI. 413, 432 (1990).

²⁸ Harald L.G. J. Merckelbach & Sophie E. M. Merckelbach, *Neurobewijs in de Rechtszaal? Eerst een Protocol*, 158 NEDERLANDS TIJDSCHRIFT GENEESKUNDE 1, 3 (2014).

²⁹ Court of Appeal Arnhem Jan. 23, 2004, ECLI:NL:GHARN:2004: AO3341.

pedestrians. However, he does not remember anything about the accident and claims to have had a 'black out'. He is seen by a neurologist who finds a perfusion defect in the brain that probably was already there at the time of the accident. The Court of Appeal considers it likely that this defect caused the defendant to lose consciousness for a short period which made him lose control over his car. The Court of Appeal concludes that it can therefore not be proven that he is guilty of the accident, and the defendant is acquitted.

We found several criminal cases in which a car accident had happened, and the question is whether this was caused by a temporary reduced consciousness or lack of consciousness of the defendant. In these cases, the courts appear to apply the so-called 'culpa in causa' principle. If loss of or reduced consciousness during the incident seems to have been likely, the subsequent question is whether the defendant could have known that the risk existed that he would have such a 'black out'. For instance because he knew he possibly had epilepsy. If that is the case, the defendant is considered responsible for taking the risk of an accident that would happen, and it is unlikely that he will be acquitted like in the above case where a previously unknown defect appeared to have caused the black out.

Accountability

In the largest category of the criminal cases found, neuroscientific information is introduced in relation to the question to what extent the defendant can be held accountable for the offense. The consequences of damage to the pre-frontal brain for the behavioral choices the person had at the time of the offense are a theme in several of the cases. An example is a case of a man who is accused of fornication with a neighbor-girl. The abuse took place four or five times when she was about nine years old.³⁰ The defendant is examined by a neurologist who finds a beginning of front-subcortical dementia in relation to Parkinson's disease. The behavioral choices of the defendant at the time of the offense were according to the neurologist, undoubtedly affected by the organic brain dysfunction. He reports:

Directly related to the front-subcortical dementia is, in addition to the characteristic cognitive impairments, impulsivity, which occurs particularly in complex situations in which the defendant lacks an overview. As a result the defendant was unable to control his impulses. He acted reflexively without overseeing the consequences. The defendant lacks the capacity for self-reflection, which prevents him from relating his actions to an appropriate framework of norms and values. In addition he was as a result of his cognitive impairment not able to interrupt his behavior once started.

The other behavioral expert, a psychologist reports that the dementia is in an early phase and that the behavior of the defendant shows not a general disinhibition yet. She reasons that there is a realistic risk of criminal recidivism. The court adopts the advice of the experts and considers the defendant of diminished accountability³¹ for the

³⁰ Court Alkmaar June 24, 2008, ECLI:NL:RBALK:2008:BK5962.

³¹ In contrast to most criminal justice systems that recognize only complete criminal responsibility or complete criminal non-responsibility, in the Netherlands a criminal law practice has developed (related to the introduction of the TBS-measure), in which five gradations of criminal responsibility have become accepted: complete responsibility, slightly diminished responsibility, diminished responsibility, severely diminished responsibility,

offense. The verdict is a 297 days prison sentence, of which 60 days conditional and with two years of probation and psychogeriatric treatment as a special condition. The dementia and the cognitive impairments and impulsivity appear to be weighed as a mitigating factor for criminal responsibility in this case, and are also seen as a risk for which supervision and treatment are needed.

In a different case, information about pre-frontal brain damage is used to underpin whether or not the defendant premeditated the offense.³² A man stabs his wife with a knife after which she dies from the wounds. The neurologist reporting in this case concludes that the defendant suffers from a slight 'frontal syndrome' (damage to the frontal brain) as a result of which he lacks impulse control and is unable to interrupt his behavior once started. After the first act of violence, the defendant went to fetch a knife. The court argues that normally it could be inferred from a situation like this that the defendant had time and opportunity to reflect on his actions, and that therefore one could conclude that the defendant premeditated the offense. However, the court concludes that because of the slight frontal syndrome, the defendant was probably not capable of such a reflection and therefore premeditation is not proven. In this case, much value is apparently assigned to the neurological information. Because of the slight frontal syndrome and its assumed consequences, the defendant is not sentenced for murder but for manslaughter. The court concludes that from expert reports it appears that the defendant should be considered of reduced accountability at the most and imposes a prison sentence of nine years.

In conclusion, in most of these 'accountability-cases' the neuroscientific or behavioral genetic information appears to be used as mitigating information. As shown earlier, in 72 cases (Table 4) neuroscientific or behavioral genetic information is introduced with respect to the question of accountability of the defendant for the offense. In 67 of these cases, the neuroscientific or genetic information influenced the decision with respect to accountability of the defendant. In the majority of these cases (55), the defendant is considered of diminished accountability and in six cases not accountable, based (in part) on the neuroscientific information. In another six of the cases, the defendant remains to be considered fully accountable (partly) on the basis of neuroscientific information. In eight of the cases not the neuroscientific information, but other factors appear to affect the judgment with respect to accountability of the defendant.

Recidivism risk

In the previous section, it was argued that in most of the cases, we found neuroscientific information to have a mitigating influence with respect to accountability. However, the other side of the coin might be that neurobiological deficits may be considered as contributing to criminal recidivism risk, particularly when they are seen as untreatable. In that case, the neurobiological information could have an aggravating role with respect to sentencing. In most criminal cases where a serious crime is at issue, the court considers the criminal recidivism risk of the offender. The behavioral experts who report in such cases, a psychiatrist (mandatory according to the law) and usually a psychologist, can be requested to advise about the risk of criminal recidivism.

and complete non-responsibility (see eg Koenraadt, *Pre-Trial Forensic Mental Health Assessment in the Netherlands*, in 3 TRANSNATIONAL CRIMINOLOGY MANUAL 527, 544 (Herzog-Evans ed., 2010).

³² Court's Hertogenbosch Sept. 5, 2007, ECL:RBSHE:2007:BB2861.

In 15 of the criminal cases, we found, neuroscientific information is explicitly mentioned in relation to the criminal recidivism risk of the defendant. An example is a case of a man who is convicted to a conditional prison sentence of three months because of stalking.³³ He has harassed his former girlfriend repeatedly with emails, phone calls, and unwanted visits because he allegedly had a strong motivation to repair the broken relationship. The report about the mental capacities of the defendant describes a personality change due to brain damage. According to the behavioral expert, the defendant is emotionally unstable and dependent. He suffers from severe intellectual disability and his capacity for impulse control is impaired. The court decides that the accountability of the defendant for the stalking is strongly diminished, but argues that because of the impaired ability of impulse control, the risk of recidivism is substantial. Therefore, treatment and supervision to prevent recidivism is urgently needed according to the court. The court takes into account that no violence was used and imposes a conditional prison sentence of three months with two years of probation. In another case, the defendant had sent letters containing shotgun cartridges and bullets to a large number of prominent persons, such as politicians and television personalities, in which he threatened to kill them and their families.³⁴ He also possessed fire arms at home, which is generally prohibited in the Netherlands. A psychiatrist and psychologist report to the court about the defendant. According to them, brain damage as a result of a traffic accident 19 years ago strongly affected his behavior at the time of the offenses. The organic damage leads to increased irritability, impulsivity, and an inability to weigh the consequences of behavioral choices. The court considers the defendant of strongly diminished accountability for the threat crimes. The behavioral experts reason that because the organic brain defects will remain stable, there is a risk of renewed threatening behavior. However, they consider the risk that the threats will amount to actual physical aggression to be very small, because the defendant is avoidant of direct personal contact and conflicts. In this case, the experts see the organic brain defects as untreatable. They however do see chances for improvement via supervision and medication of the general condition and behavioral regulation of the defendant in such a way that the recidivism risk may be reduced.

These two cases are interesting because they illustrate that although the brain damage and cognitive deficits are seen as unchangeable and as the source of criminal recidivism risk, the behavioral experts and the court nevertheless see opportunities for improvement that may lead to a reduction of the recidivism risk. The assumption that diagnosed neurobiological deficits may act as a 'double edged sword', mitigating with respect to the accountability of the defendant but aggravating with respect to sentencing because of the perceived untreatable recidivism risk, is thus at most partly confirmed in these cases.

Addiction and accountability

For courts in the Netherlands, the most common way to look at offenders who committed their offense while intoxicated by alcohol or other addictive substances is indicated

³³ Court's-Hertogenbosch Apr. 9, 2009, ECLI:NL:RBSHE:2009:BI0552.

³⁴ Court Rotterdam Apr. 28 2004, ECLI:RBROT:2004:AO8559.

by the ‘culpa in causa’ principle.^{35,36} Culpa in causa is used in criminal law to indicate that someone ended up in a situation that results in an unlawful act because of his or her own fault and therefore is responsible for it.

Whereas in the criminal law sector addiction seems to be seen more as a choice, in the medical sector addiction is seen as a (brain) disease.³⁷ According to the brain disease model, chronic drug use induces enduring changes in brain function that impair the person’s ability to control drug use.³⁸ Several findings support the disease model. For instance only a minority of the people who start using drugs or alcohol develop an addiction, and a subset of people more likely to become addicted can be identified on the basis of genetic risk factors.³⁹ Furthermore, neuroimaging studies have revealed structural changes in the ‘reward circuitry’ of the brain of addicted persons and in brain circuits that are implicated in cognitive control, compared to non-addicted persons.⁴⁰ According to the brain disease model, these brain changes explain the maladaptive cognitive processes seen in addicted persons, such as heightened attention to the addictive substance, impaired ability to control strong emotions or inhibit intentional actions, and problems in making adaptive decisions.

Although the ‘culpa in causa’ principle prevails, the neuroscientific knowledge about addiction that has developed during the last decades appears to be affecting the way addicted offenders are perceived by actors in Dutch courts, mainly by the behavioral experts. It seems that the neurobiological knowledge is triggering questions and discussion about the consequences of addiction and long-term substance abuse for brain functioning and behavioral choices of the defendant. A practical example is a case of a defendant who committed murder during an amphetamine psychosis. The psychiatrist who reports to the court argues: ‘The accused was free to choose or not choose to start with amphetamine long ago. However, generally a long existing addiction has irreversible effects on the brain that limit the freedom to determine one’s will to use substance’. For this reason, the psychiatrist advises the court to consider the defendant of diminished criminal responsibility.⁴¹ Another expert in this case however states that: ‘The accused should have known amphetamine can lead to a psychosis’, and advises the court to consider the defendant completely responsible. The Court of Appeal Leeuwarden adopts the reasoning of the first expert. But in the final judgment in this case the Court of Appeal Arnhem to which the case has been sent by the Supreme Court after the latter quashed the verdict of Court of Appeal Leeuwarden, says that the defendant should have known that amphetamine could have consequences to his psychological well-being. Because the defendant voluntarily started to use and continued using the

³⁵ Eg Jos van Mulbrecht & Frans Koenraadt, *Het Bereik van Zelfintoxicatie: Alles Behalve een Vrijbrief*, 62 ARS AEQUI 750, 754 (2013).

³⁶ Eg Supreme Court of the Netherlands June 9, 1981, ECLI:NL:HR:1981:AC0902; and Feb.12, 2008, ECLI:NL:HR:2008:BC3797

³⁷ Alan I. Leshner, *Addiction is a Brain Disease, and it Matters*, 278 SCIENCE 45, 47 (1997).

³⁸ Nora D. Volkow, Joanna S. Fowler & Gene-Jack Wang, *The Addicted Human Brain: Insights From Imaging Studies*, 111 J. CLIN. INVEST. 1444, 1451 (2003).

³⁹ Eg Peter Mayer & Volker Holt, *Genetic Disposition to Addictive Disorders*, 5 CURR. OPIN. PHARMACOL. 4, 8 (2005).

⁴⁰ Peter W. Kalivas & Nora D. Volkow, *The Neural Basis of Addiction: Pathology of Motivation and Choice*, 162 AM. J. PSYCHIAT. 1403, 1413 (2005).

⁴¹ Expert (psychiatrist) in Court of Appeal Leeuwarden Apr. 16, 2007, ECLI:NL:GHLEE:2007:BA3007.

drug, the Court of Appeal Arnhem does not consider him of diminished responsibility for his criminal acts because of the amphetamine psychosis (although he is considered of partly diminished responsibility because of a narcissistic personality disorder).⁴²

Neuroscience may help criminal law practitioners to understand better the mechanisms of obstacles to self-control in addicted persons.⁴³ Furthermore, as Kennett points out, neuroimaging and neuropsychological testing may provide objective measures of for instance hyper-responsiveness to substance-related stimuli, impairments in self-control, and decision-making. Such instruments may (eventually) help identify those addicts who have such severe problems with self-control and decision-making that they should be considered of diminished responsibility.

At present, researchers work on a range of neurocognitive instruments.^{44,45,46} An indication that these may be promising for the criminal justice context too, is that in clinical practice, neurocognitive measures have shown to be better able to identify addicted persons with a high risk of relapse than do traditional clinical instruments such as questionnaires or structured interviews.^{47,48,49}

Duress or excessive self-defense

In a minority of the criminal cases found, information about head injury or brain damage is used to argue that the defendant was extra vulnerable to duress. In some cases, it is argued in the context of self-defense that because of a head injury or brain damage the defendant may be extra vulnerable for a 'state in which strong emotions prevail' ('hevigemoedstoestand'), and may therefore be more likely to use excessive self-defense. An example is a case of a defendant who is accused of assault.⁵⁰ The defense argues that there was excessive self-defense because the defendant suffered a concussion due to a blow to his head (from the later victim) and subsequently came into a 'strong emotional mental state'. As a consequence of this 'strong emotional mental state', the defendant hit the victim back. These arguments of the defense do however not convince the Court of Appeal of the existence of a 'strongly emotional mental state' and increased vulnerability for excessive self-defense of the defendant at the time he hit the victim.

Another example concerns a defendant with brain damage, presumably due to prolonged abuse of alcohol and drugs. The defendant has inter alia memory problems, a low frustration tolerance and poor control of his emotions.⁵¹ The defendant is accused

⁴² Court of Appeal Arnhem Feb. 17, 2010, ECLI:GHARN:2010:BL4185.

⁴³ Jeanette Kennett, *Addiction, Choice, and Disease: How Voluntary Is Voluntary Action in Addiction?*, in *NEUROSCIENCE AND LEGAL RESPONSIBILITY* 257, 278 (Nicole A. Vincent ed., 2013).

⁴⁴ Geert Dom et al., *Substance Use Disorders and the Orbitofrontal Cortex: Systematic Review of Behavioural Decision-Making and Neuroimaging Studies*, 187 *BRIT. J. PSYCHIAT.* 209, 220 (2005).

⁴⁵ Ingmar H. Franken et al., *Error-Processing Deficits in Patients with Cocaine Dependence*, 75 *BIOL. PSYCHOL.* 45, 51 (2007).

⁴⁶ REINOUT W. WIERS & ALAN W. STACEY, *HANDBOOK OF IMPLICIT COGNITION AND ADDICTION* (2006).

⁴⁷ Eg Marlies A. E. Marissen et al., *Attentional Bias Predicts Heroine Relapse Following Treatment*, 101 *ADDICTION* 1306, 1312 (2006).

⁴⁸ Anna E. Goudriaan et al., *The Role of Self-Reported Impulsivity and Reward Sensitivity Versus Neurocognitive Measures Of Disinhibition and Decision-Making in the Prediction of Relapse in Pathological Gamblers*, 14 *PSYCHOL. MED.* 1, 11 (2007).

⁴⁹ Martin P. Paulus, Susan F. Tapet & Marc A. Schuckit, *Neural Activation Patterns Of Methamphetamine-Dependent Subjects During Decision-Making Predict Relapse*, 62 *ARCH. GEN. PSYCHIAT.* 761, 768 (2005).

⁵⁰ Court of Appeal 's-Hertogenbosch Nov. 3, 2009, ECLI:NL:GHSHE:2009:BK1796.

⁵¹ Court of Groningen Dec. 13, 2007, ECLI:NL:RBGRO:2007:BC0127.

of manslaughter of a man after a fight between the two of them. The defense lawyer argues that the defendant used (excessive) self-defense due to physical and mental vulnerability and impaired impulse control in combination with the threatening situation. The defendant allegedly came into a state of reduced consciousness and would subsequently out of fear have acted impulsively. The court does not accept the reasoning of the defense lawyer because the court's analysis of the subsequent events during the fight does not confirm the arguments of the defense.

To summarize, in a few cases, we found information about assumed neurocognitive deficits of the defendant was brought up as mitigating information by the defense in the context of extra vulnerability to duress and (excessive) self-defense of the defendant. This reasoning was however not successful in any of the cases we found. One reason for that appears to be that the claims that the defendant was extra vulnerable for a strong emotional state or (excessive) self-defense do not seem to be substantiated further by tests of mental capacities of the defendant or other evidence.

BEHAVIORAL GENETIC INFORMATION

As mentioned earlier, the majority of the cases found are cases in which neuroscientific information is introduced. Behavioral genetic information is involved in 13 cases, and in another 10 cases neuroscientific information as well as behavioral genetic information is involved. In most of these cases, the only reference to 'behavioral genetic information' is a mentioning of the role of heritable factors in the etiology of mental disorders, such as schizophrenia or psychoses (seven cases), autism spectrum disorders (two cases), or personality disorder (three cases). The experts in most of these cases (usually a psychiatrist and psychologist) use the information about heritable factors (and other factors, such as problematic family conditions) merely to explain how the disorder and the problematic behavior may have come about, and the court does not mention this information in its argumentation. Nevertheless, there are also a number of cases in which the behavioral genetic information is used to help answer judicial questions.

In one case, the defendant has a heritable neurological disorder, Huntington's disease, which is known to be caused by an aberrant gene on the fourth chromosome. The defendant is accused of setting fire to the house of his girlfriend, bringing the lives of several people into danger.⁵² Huntington's disease is the cause of neuropsychological problems and dementia which make it difficult for him to deal with daily life and with problem situations. In such situations, he reacts with impulsive aggression. The defendant is considered completely unaccountable by the court for his crimes. However, the neuropsychological problems and their worsening because of the expected progression of the disease are likely to enhance the risk of criminal recidivism, according to the behavioral experts reporting to the court. Therefore, the court orders that the defendant be committed to a psychiatric hospital, a measure that can be continued as long as the person is a risk to others.⁵³ In this case, the genetic defect and the knowledge about its course and effects on the cognitive capacities and the behavior do not lead to any optimism by the experts about opportunities for reduction of criminal recidivism risk.

⁵² Court of Alkmaar Dec. 28, 2010, ECLI:NL:RBALK:2010:BO9228.

⁵³ Art. 37 of Criminal Code.

Addiction often runs within families, and genetic studies have shown that heritable factors account for 40–60 per cent of the risk to develop an addiction.⁵⁴ In six of the cases, we found, experts mention a heritable factor which makes the addicted defendant involved more inclined than an average person to develop substance dependence. In one of these cases, the defendant is sentenced for severe assault and threatening to kill his father.⁵⁵ The psychiatrist reports that in developing alcohol dependence, ‘a genetic factor via father and a contextual factor seem to have played a role’. The psychiatrist considers the offense as mainly related to alcohol dependence, and states that the defendant is fully criminally responsible. The court, however, does not adopt the reasoning of the psychiatrist but argues that the ‘genetic component indicates that it cannot be completely excluded that the defendant did not commit the offenses voluntarily (reduced free will), and therefore the presence of criminal responsibility is questionable’. In this case, the court uses the ‘genetic component’ and its presumed consequences: limiting the behavioral choices of the defendant, as an argument to consider the defendant of diminished responsibility for his crimes. The reasoning in this case appears to be comparable to that of the court in a recent Italian criminal case where the influence of the MAOA-gene on aggressive behavior played a role. In the first case, a male who had been diagnosed with schizophrenia had stabbed another man to death.⁵⁶ The defendant had not been taking his medication and was actively psychotic during the offense. He was found guilty by a first instance court and was given a reduced sentence of nine years because of his mental disorder. The Court of Appeal subsequently reduced the sentence to eight years based on the fact that the defendant tested positively for genetic variants that made him prone to aggression under stressful circumstances.

Several authors have criticized the basing of the judgment of criminal responsibility and the sentence (partly) on genetic characteristics of the defendant.^{57,58} Morse for instance argues that evidence of a causal relationship between a genetic variant and an elevated proneness to for instance impulsive aggression should not be equaled to an excusing condition. Only if independent evidence would show that for instance the ability of the defendant to control strong emotions is compromised and that this influenced the offense, could there be an excusing condition. Morse points out that an individual should not be judged on the basis of risk factors for developing a certain behavior, but on the basis of his mental capacities at the time of the offense. Empirical findings nevertheless indicate that the latter can be closely related to genetic characteristics.⁵⁹

In two cases, we found it is mentioned that pedophilia is ‘genetic’ or ‘inborn’. In one of these cases, the defense lawyer states that the pedophile orientation of the defendant leads to strong emotions and a heavy pressure to view child pornography that

⁵⁴ PETER MCGUFFIN, MICHAEL J. OWEN & IRVING I. GOTTESMAN (EDS.), *PSYCHIATRIC GENETICS AND GENOMICS* (2002).

⁵⁵ Court of Appeal the Hague Feb. 22, 2010, ECL:NL:GHSGR: 2010:BL7187.

⁵⁶ Emiliano Feresin, *Lighter Sentence for Murderer With ‘Bad Genes’*, NATURE NEWS, Oct. 30, 2009, DOI: 10.1038/news.2009.1050.

⁵⁷ Francesca Forzano et al., *Italian Appeal Court: A Genetic Predisposition to Commit Murder?*, 18 EUR. J. HUM. GENET. 519, 521 (2010).

⁵⁸ Stephen J. Morse, *Genetics and Criminal Responsibility*, 15 TRENDS COGN. SCI. 378, 380 (2011).

⁵⁹ Eg Naomi I. Eisenberger et al., *Understanding Genetic Risk for Aggression: Clues from the Brain’s Response To Social Exclusion*, 61 BIOL. PSYCHIAT. 1100, 1108 (2007).

is extremely hard for him to resist and that he should not be held responsible for.⁶⁰ The defense lawyer also asks the question ‘whether a pedophile can be held morally responsible for his sexual orientation, when you realize that it originated from a genetic background and atypical brain development’, citing a professor whose name is not mentioned in the case. The court, more in line with the reasoning by Morse than the court in previous case, does not accept this argumentation and concludes that, although the defendant may not be held responsible for his pedophile orientation, this does not imply that he cannot be held responsible for his pedophile actions: gathering and spreading child pornographic materials, and molesting a very young child. In addition, the court mentions that two behavioral experts report that the defendant has ‘normal abilities of impulse control’.

Another context in which genetic factors are mentioned is that of personalized treatment. In one of the cases found is a particular gene (MAOA-gene) mentioned in relation to treatment of aggressive behavior.⁶¹ This concerns the case of a TBS-patient who is detained in a so-called ‘long-stay unit’ within a forensic psychiatric detention center, a unit for patients who the center considers to have no perspective of successful treatment to reduce their risk of criminal recidivism. The patient has attacked three members of the staff with a pair of scissors that he had especially prepared for this goal. The court considers him guilty of attempted murder and premeditated serious assault. Behavioral experts, a psychiatrist and a psychologist, report that the patient has severe antisocial and narcissistic personality disorder and cocaine dependence in remission. They consider aggression regulation a severe problem in this patient, with respect to reactive as well as instrumental aggression. The risk of violent recidivism is seen as strongly elevated. The experts advise to place the patient in a high-security prison unit, since the TBS-treatment has led to no improvement. They also advise to investigate if in that setting the difficult to treat aggression regulation problems can be influenced pharmacologically. It is in this context that the MAOA-gene is mentioned. The psychiatrist is quoted saying: ‘If it appears that the patient has a reduced expression of the MAOA-gene (the so-called ‘warrior-gene’) a pharmacological treatment with Depakine could be started’.⁶² The court adopts the expert’s advice and sentences the patient to nine years imprisonment. Depakine (valproate) is one of the most prescribed medications for epilepsy. Because valproate has a mood- and impulse-stabilizing effect, it is also prescribed in some cases by psychiatrists to reduce aggressive behavior.⁶³

Researchers expect that subtyping of groups of addicted patients on the bases of genetic, neurobiological, and clinical variables will become more important for effective (personalized) treatment and risk assessment, which is also relevant for the judicial context.⁶⁴

⁶⁰ Court of Amsterdam July 23, 2012, ECLI:NL:RBAMS:2012:BX2325.

⁶¹ Court ‘s-Hertogenbosch Sept. 6, 2012, ECLI:NL:RBSHE:2012:BX6467.

⁶² Why exactly the psychiatrist mentions Depakine/valproate in relation to ‘the reduced expression of the MAOA-gene’ is not explained further in the case. A forelaying guess is the assumption that Depakine/valproate activates the MAOA-system [Jason B. Wu & Jean C. Shih, *Valproic Acid Induces Monoamine Oxidase A Via Akt/Forkhead Box O1 Activation*, 80 MOL. PHARMACOL. 714, 723 (2011).

⁶³ Eg Laurette E. Goedhard et al., *Pharmacotherapy for the Treatment of Aggressive Behavior in General Adult Psychiatry: A Systematic Review*, 67 J. CLIN. PSYCHIAT. 1013, 1024 (2006).

⁶⁴ Henry R. Kranzler & James R. McKay, *Personalized Treatment of Alcohol Dependence*, 14 CURR. PSYCHIAT. REP. 486, 493 (2012).

CONCLUDING REMARKS

Searching the years 2000–12 in the database of Dutch case law on *Rechtspraak.nl* yielded 231 criminal cases that met the selection criteria that neuroscientific or genetic information is introduced with respect to the suspect or defendant and in relation to behavior, brain function, or mental state. In the cases that were found, behavioral genetic information is rare. In most of the cases found, neuroscientific information is part of a more comprehensive examination of the mental capacities of the defendant. The neuroscientific information is typically one of the components of a larger picture, in addition to for instance psychiatric and psychological examinations and reports from the probation service. In the cases found, defendants *inter alia* suffer from diverse neurobiological phenomena: eg frontal dementia, addiction, epilepsy, and sleep disorder. MRI, EEG, neuropsychological tests, and physiological sleep examination are techniques employed for gathering neuroscientific information in the cases found. In some cases, the role of neuroscientific information with respect to the decision of the court is quite large, for instance in the case where the defendant was considered of reduced accountability for his crimes partly on the bases of neurobiological information, or in the case the defendant was acquitted largely on the basis of physiological sleep assessment. In other cases, it is only small. Neuroscientific information is introduced with respect to all of the judicial questions that are addressed in the Dutch criminal trial and sentencing. A limitation is that our research is based on published cases and that we do not know whether they form a representative subset of all relevant cases (including the unpublished ones).

In the majority of the cases found, neuroscientific information is introduced as mitigating information in sentencing. In such cases, there is often a presumption that the defendant has a mental disorder or defective development that may have limited his responsibility for his criminal actions, and in which neurobiological aspects may play a role. Although the information is considered as mitigating, it is mentioned in the literature that neuroscientific information may also function as a ‘double edged sword’.⁶⁵ On the one hand, it may be considered mitigating information with respect to accountability, and may therefore contribute to the underpinning of a reduction of the sentence. On the other hand, neuroscientific information can contribute to the extent to which a defendant is perceived as a risk for society, for instance when neurobiological damage is perceived as untreatable. In the latter case, this may although the defendant can be considered diminished or not responsible for the crime, in practice lead to a longer sentence, such as a TBS-hospital order that can be periodically extended. Some of our cases seem to confirm this line of reasoning (such as the Huntington’s disease case). However, others nuance it, for instance the cases of a stalker where the behavioral experts see room for improvement and reduction of recidivism risk, despite ‘untreatable’ neurobiological deficits that are assumed to contribute to recidivism risk. A difference with the Huntington’s disease case is that in these latter cases the experts thought that the risk of threatening behavior was high, but the chance of direct personal violence was

⁶⁵ Lisa G. Aspinwall, Teneille R. Brown & James Tabery, *The Double-edged Sword: Does Biomechanism Increase or Decrease Judges’ Sentencing of Psychopaths?* 337 *SCIENCE* 846, 849 (2012). Although it considers the possibility of a ‘double edged sword’, this study finds nevertheless that judges impose mainly milder sentences when confronted with neuroscientific information.

small. The ‘double edged sword-effect’ may be most prominent in cases with a high risk of severe violence.

Some of the ways neuroscientific information is used in criminal cases in other countries were not found in any Dutch cases. This concerns for instance physiological ‘lie-detection’ or ‘fMRI-lie detection’. The scientific base for using these methods as evidence in court is considered too weak. In some cases in the USA, the involvement of information about the ‘emotional brain’ such as dysfunction of the amygdala–hippocampal complex is introduced in relation to psychopathy. In the Netherlands, such information was not used in any of the cases found. Several criminal cases were found in which neurobiological or behavioral genetic aspects of addiction were discussed. However, in contrast to for instance Canada⁶⁶, no cases were found in the Netherlands with a defendant who was diagnosed with the fetal alcohol syndrome. Although the number of cases is expected to grow by some (see Introduction), in only one of the Dutch cases found, a candidate gene for aggression (eg MAOA-gene) was mentioned in relation to medical treatment of impulsive aggression. In contrast to countries like Italy, in none of the Dutch cases found defendants appeared to have been tested for the MAO-gene or other candidate genes. Nevertheless, the impact of ‘heritable factors’ on the behavioral choices of the defendant is a question that is addressed in several of the cases found.

Clearly, the actors, behavioral as well as judicial, in criminal cases in the Netherlands ask questions about what the implications of neuroscientific factors are for criminal responsibility, recidivism risk, or the best choice of treatment in the case of their defendant. The cases also show that views on the impact that neuroscientific information could or should have can be far apart, for instance in cases where the impact of genetic factors is an issue, or with respect to questions about criminal responsibility in relation to the impact of neurobiological damage in an addicted defendant.

One area in which neuroscience may help to gain more insight is the impact of age, mental disorders, personality disorders, and addiction on the capacity to make decisions.⁶⁷ Neuropsychological tests and neuroimaging may provide objective measures for instance for attentional bias, impairments in self-control, and problems with decision-making in for instance addicted persons, and may in time help identify those addicts who have such severe problems with self-control or decision-making that they should be considered of diminished criminal responsibility.⁶⁸

The development of guidelines and protocols for the use of neuroscientific information in criminal court (as in physiological sleep disorder assessment) may be advisable for other phenomena, such as pre-frontal brain damage, learning disabilities, or mental disorders such as schizophrenia as well. Not only because they could serve to articulate the state of the knowledge and ways in which neuroscientific information can and cannot be used, but also because they could be helpful to prevent biases to which neuroscientific evidence in the judicial context is vulnerable.⁶⁹

⁶⁶ See the paper by Jennifer Chandler, this issue.

⁶⁷ Gerben Meynen, *A Neurolaw Perspective on Psychiatric Assessments of Criminal Responsibility: Decision-Making, Mental Disorder, and the Brain*, 36 INT’L. J. L. PSYCHIAT. 93, 99 (2013).

⁶⁸ Kennett, *supra* note 42, at 257–278.

⁶⁹ Harald Merckelbach & Sophie E. M. Merckelbach, *Neurobewijs in de Rechtszaal? Eerst een Protocol* (‘Neuro-evidence in court? First a protocol’), 158 NEDERLANDS TIJDSCHRIFT GENEESKUNDE 1, 3 (2014).

An issue in the Netherlands is that the pool of experts who report to the criminal courts about neuroscientific information is rather small. For instance, in the majority of cases in which neurological information was reported in relation to aggressive behavior, the same 'behavioral neurologist' was consulted. For the growth of expertise in this area, it is important to have more professionals. The pool of neuropsychologists appears to be somewhat larger, since in the cases found, more different neuropsychologists reported.

Another important area for judicial practice is risk assessment. In several of our cases, behavioral experts explicitly relate neurobiological factors to criminal recidivism risk. A modest number of empirical studies are beginning to show how neuroscientific information can have an additive value for assessment of criminal recidivism risk.^{70,71,72} Furthermore, research indicates that neurobiological factors may help predict who may and may not profit from cognitive behavioral treatment for antisocial behavior.⁷³ Although much is still unknown about the relation between neurobiological factors and behavioral choices, 'neurolaw' is an area of research that offers chances to develop instruments to help answer judicial questions in criminal cases, that have an additive value with respect to practice as usual. To develop such instruments, practice oriented research is needed, as well as a dialog between researchers and legal practitioners.

APPENDIX: CRIMINAL CASES AND PUBLICATION PRACTICE IN THE NETHERLANDS

Criminal cases

Yearly more than a 100–1000 criminal cases⁷⁴ are processed in first instance criminal courts in the Netherlands (Table 5).⁷⁵ Of these cases, about 80 per cent are single judge decisions, mostly 'police-judge'-cases (politierechterzaken). For instance in 2011, 84.322 (80.7 per cent) of the 104.542 criminal cases in a first instance court were 'police-judge cases'.⁷⁶ In general, the less complex criminal cases are processed by a single judge and the more complex cases and more serious crimes by a court of three judges. In 2011, for instance, 12.777 (11.6 per cent) of the criminal cases were processed by a court of three judges. Finally in 2011, 7.988 (7.6 per cent) of the criminal cases were juvenile court cases.

In addition to the criminal cases in first instance courts mentioned in the table, the Courts of Appeal process about 40,000 criminal appeal-cases each year, including offenses as well as crimes (Table 5), and the Supreme Court of the Netherlands process around 3000–4000 criminal Supreme

⁷⁰ Lea H. Studer, A. S. Aylwin & John Reddon, *Testosterone, Sexual Offense Recidivism, and Treatment Effect among Adult Male Sex Offenders*, 17 SEX. ABUSE 171, 181 (2005).

⁷¹ Marjan De Vries-Bouw et al., *The Predictive Value of Low Heart Rate and Heart Rate Variability During Stress for Reoffending in Delinquent Male Adolescents*, 48 PSYCHOPHYSIOLOGY 1596, 1603 (2011).

⁷² Eyal Aharoni et al., *Neuroprediction of Future Re-arrest*, 110 PROC. NATL. ACAD. SCI. USA 6223, 6228 (2013).

⁷³ Liza J. M. Cornet et al., *Neurobiological Changes after Intervention in Individuals with Anti-social Behavior: A Literature Review*, 25 CRIM. BEHAV. MENT. HEALTH 10, 27 (2015); Liza J. M. Cornet et al., *Neurobiological Factors as Predictors of Cognitive-Behavioral Therapy Outcome in Individuals with Antisocial Behavior: A Review of the Literature*, 58 INT'L J. OFFENDER THER. COMP. CRIMINOL. 1279, 1296 (2014); Liza J. M. Cornet et al., *Neurobiological Factors as Predictors of Prisoners' Response to a Cognitive Skills Training*, 43 J. CRIM. JUST. 122, 132 (2015).

⁷⁴ Including almost only crimes (serious offenses such as violence, sexual offenses, property crimes, and traffic offenses).

⁷⁵ Sources: statistics Netherlands (www.CBS.nl); Marisca Brouwers, M. & Anton Th. J. Eggen, *Berechting in CRIMINALITEIT EN RECHTSHANDHAVING* (Sandra Kalidien ed., 2012). Periodical electronic publication of criminal justice figures at www.wodc.nl (accessed Aug. 26, 2014).

⁷⁶ See *supra* note 75.

Table 5. Cases processed yearly by criminal courts in the Netherlands.

<i>Year</i>	<i>Total no. of criminal cases in first instance criminal courts per year^a</i>	<i>Total no. of appeal criminal cases in Courts of Appeal per year^b</i>	<i>Total no. of criminal cases in Supreme Court per year^c</i>
2000	111.033		
2001	112.037		
2002	116.810		
2003	134.631		
2004	133.218		
2005	132.595	39.910	3.378
2006	134.375	39.290	3.067
2007	127.579	38.080	3.034
2008	127.389	36.370	2.971
2009	126.990	37.510	3.364
2010	109.527	37.820	3.431
2011	104.542	38.790	3.868
2012	95.910	38.500	3.403

^aTotal no. of criminal cases in first instance criminal courts per year.

^bTotal no. of appeal criminal cases in Courts of Appeal per year.

^cTotal no. of criminal cases in Supreme Court per year.

Court cases a year, including offenses as well as crimes (Table 5). Of all these court decisions, only a fraction is published.

Jurisprudence publication practice

There is a legal framework for publication of case law in the Netherlands.⁷⁷ The basis is that decisions (judgments) of the courts are to be pronounced in public in order to avoid secret judgments and to oversee the judiciary. Provision of decisions used to be passive: one could ask the court to provide a particular decision. There is no formal legal framework about the general active provision of judgments such as in journals and more recently online. However, according to Van Opijnen, the clearest normative instruction regarding publication of judicial decisions is Recommendation R (95)11 of the Committee of Ministers of the Council of Europe. According to Van Opijnen, this source indicates a limited obligation to publish court decisions: a representative selection is sufficient.

Rechtspraak.nl is the official public website of the Dutch Judiciary. The Dutch case law repository and search engine are an important part of the site, and have developed rapidly since the start in 2000.

⁷⁷ Mark van Opijnen, *On and in the Web: How the Accessibility of Judicial Decisions Can be Improved* (2014) [PhD Thesis, University of Amsterdam (in Dutch with summary in English)] <http://dare.uva.nl/record/466352> (accessed Aug. 1, 2014).

Rechtspraak.nl is now most important open source for case law in the Netherlands. The Judiciary in the Netherlands has defined their own criteria for online publication of judicial decisions. Regarding availability they have for instance formulated that decisions should be available without payment, via a single website, and decisions should be identifiable by unique labels.

Until early 2012, criteria for publication of decisions in *Rechtspraak.nl* were mainly whether publication of the decision in question was of interest technically for judicial professionals, (for instance because it introduced a different line of reasoning), or if publication of the case was of interest for (subgroups of) the public at large (eg a high-profile case that drew much attention of the media).⁷⁸ The published cases are therefore not a representative set of the total number of criminal cases in the Netherlands.

Several researchers have criticized the publication practice in the Netherlands, arguing that only a tiny fraction (not even 1 per cent) of the total number of judicial decisions is published and that this seriously hampers scientific research on case law because the set is too small and is not representative of the total number of cases.⁷⁹ Others state that some nuancing may be justified here, because not all cases may be equally relevant to publish.⁸⁰ As mentioned above, a large proportion of the judicial decisions concern 'light' cases, often processed by a single judge, that were for instance terminated without a decision, with a decision that contains only 'standard formulations', or with an oral decision only (eg a fine for parking in the wrong place). Van Opijnen shows that in 2009 for example, more than 80 per cent of the cases processed by criminal courts were such light cases, while the remaining cases were substantial.⁸¹ In 2009, *Rechtspraak.nl* published 8 per cent of the substantial cases processed by first instance criminal courts (15.9 per cent of cases processed by a court of three judges and 1.6 per cent of cases processed by a single judge). In that same year, *Rechtspraak.nl* published 7.2 per cent of the substantial cases processed by criminal Courts of Appeal.⁸² Although one can disagree about what would be a 'sufficient' proportion to publish, the proportion of cases published is at least higher for cases with a substantial content, than for 'all cases'.

Furthermore, in 2012 the selection criteria for publication of decisions in *Rechtspraak.nl* were broadened, and the definitions of the criteria were made more concrete.⁸³ In the new criteria however, complete inclusion is sought of several categories of cases. For instance all cases of the highest courts are published. Another example is that all cases are published in which a prison sentence of four years or more, and/or a TBS entrustment order is imposed, as well as all cases in which the defendant is accused of any crime 'against life', such as murder and manslaughter. If this is realized, it will be interesting for research because it creates an opportunity to draw conclusions about representative categories of criminal cases.

The content of published decisions

As a result of several projects of the Council for the Judiciary to improve the justification of verdicts, since 2006 the text of published decisions is structured according to a fixed format.⁸⁴ Since then most decisions contain information about the content of the charge(s), sources of evidence used, positions of the prosecution and defense, qualification of offenses by the court, punishability of offenses,

⁷⁸ Selection criteria for publication on *Rechtspraak.nl* 1999. Mark van Opijnen, 2014 *supra* note 77.

⁷⁹ Lauren Mommers, Gerrit J. Zwenne & Bart W. Schermer, *Het Best Bewaarde Geheim van de Raadkamer*, 85 NEDERLANDS JURISTENBLAD 2072, 2078 (2010).

⁸⁰ Mark van Opijnen *supra* note 77.

⁸¹ *Id.* at 230.

⁸² *Id.*

⁸³ De Raad voor de Rechtspraak, de Hoge Raad der Nederlanden, de Afdeling bestuursrechtspraak van de Raad van State en de besturen van de rechtbanken, de gerechtshoven, de Centrale Raad van Beroep en het College van Beroep voor het bedrijfsleven, *Decision selection criteria for publication on Rechtspraak.nl*, Mar. 26, 2012, <http://www.rechtspraak.nl/Uitspraken/Selectiecriteria/> (accessed Aug. 1, 2014).

⁸⁴ Den Haag: Raad voor de Rechtspraak, *Projectgroep PromisII, Eindrapport Promis II: Project motiveringsverbetering in strafvonnissen*, 2007, http://www.rechtspraak.nl/Organisatie/Raad-Voor-De-Rechtspraak/Kwaliteit-van-de-Rechtspraak/Documents/Integraal-eindrapport-Promis_def.pdf (accessed Aug. 26, 2014).

punishability of the defendant, motivation by the court of the sentence, and the verdict: the main conclusions and sanctions. The text of the decisions does not include attachments like appointments of experts, expert reports, concluding arguments of the prosecutor, or concluding arguments of the defense. To find these sources of information, it is necessary to study the case files of the defendant. These are not public, but can after a permission procedure be accessed for research purposes through the prosecution service and/or the courts. More and more of the case files are digitalized by the courts.⁸⁵ The decision does not contain verbal transcripts of trial hearings, and these are not available via other sources either because they are rarely made in the Netherlands.

⁸⁵ Mark van Opijnen *supra* note 77, at 188; Chapter 3.