

## Rassegne

# Free will, neuroscience, and choice: towards a decisional capacity model for insanity defense evaluations

## *Libero arbitrio, neuroscienze e scelta: verso un modello basato sulla capacità decisionale per la valutazione dell'imputabilità*

GIOVANNA PARMIGIANI<sup>1\*</sup>, GABRIELE MANDARELLI<sup>1</sup>, GERBEN MEYNEN<sup>2</sup>, LORENZO TARSITANI<sup>1</sup>, MASSIMO BIONDI<sup>1</sup>, STEFANO FERRACUTI<sup>1</sup>

\*E-mail: giovanna.parmigiani@uniroma1.it

<sup>1</sup>Department of Neurology and Psychiatry, "Sapienza" University of Rome, Rome, Italy

<sup>2</sup>Department of Criminal Law, Tilburg University, Tilburg, the Netherlands

**SUMMARY.** Free will has often been considered central to criminal responsibility. Yet, the concept of free will is also difficult to define and operationalize, and, moreover, it is intensely debated. In particular, the very existence of free will has been denied based on recent neuroscience findings. This debate has significant implications on those fields in which the link between free will and behaviour is the main focus of interest, such as forensic psychiatry. In fact, a tension is often experienced between the centrality of the notion of free will on the one hand, and its controversial status on the other. This tension needs to be addressed, especially in forensic psychiatry, since it is relevant for actual assessments of legal insanity. In the present paper we will try to operationalize "free will" using a fourpartite decision-making capacity model, which can be used in forensic assessment of insanity. We will describe its advantages and application to guide mental insanity assessments. Whereas free will is often considered problematic from a neuroscience perspective, this model, we argue, is compatible with neuroscience; moreover, evaluations using this model can also be informed and strengthened by neuroscientific findings, for example regarding inhibitory control.

**KEY WORDS:** free will, freedom, personal autonomy, mental disorders, volition, decision making, competence.

**RIASSUNTO.** Il libero arbitrio è stato spesso considerato una tematica centrale nella dottrina della responsabilità criminale. Ciononostante, il concetto stesso di libero arbitrio presenta intrinseche problematiche nella sua definizione teorica e applicazione pratica in un contesto clinico/forense ed è intensamente dibattuto. Nello specifico, l'esistenza stessa del libero arbitrio è stata recentemente posta in discussione anche sulla base di alcune evidenze sperimentali neuroscientifiche. Questo dibattito ha implicazioni significative in quei campi in cui l'associazione tra libertà di scelta e comportamento costituisce il *focus* di interesse, quali la psichiatria forense. Esiste inoltre una sorta di conflittualità tra la centralità e concezione teorica del libero arbitrio (*free will*) e il suo *status* e applicazione pratica. Questo problema ha bisogno di essere affrontato, specialmente all'interno della psichiatria forense, dal momento che risulta rilevante per l'effettiva valutazione dell'infermità di mente. Nel presente articolo cercheremo di rendere operativo il concetto del "libero arbitrio" utilizzando il modello a quattro dimensioni utilizzato per la capacità decisionale, che può essere impiegato nella valutazione forense dell'infermità di mente. Descriveremo i suoi vantaggi e applicazioni per guidare la valutazione dell'infermità di mente. Mentre il libero arbitrio è spesso considerato problematico dal punto di vista delle neuroscienze, questo modello, a nostro avviso, è compatibile con le neuroscienze; inoltre, le valutazioni che utilizzino questo modello possono anche essere arricchite e rafforzate dalle scoperte neuro scientifiche, per esempio riguardo il controllo inibitorio.

**PAROLE CHIAVE:** libero arbitrio, libertà, autonomia personale, disturbi mentali, volizione, capacità decisionale, capacità.

### INTRODUCTION

Despite the general belief in a physical universe governed by natural law<sup>1</sup>, human beings tend to consider themselves as free subjects endowed with free will. The sensation of being voluntarily in control of a large proportion of one's own actions, behaviours and life is a subjective, intuitive, and pervasive characteristic of human experience<sup>2</sup>. Human beings experience freedom, in the sense of free will, as the power to

determine their actions. This is one of the basic and constitutive experiences of our life, and it shapes our personal and moral identity for everyone. It is in fact through voluntary decisions that we affirm and show who we are compared to what we would or could have been<sup>3</sup>.

Nonetheless, in the last decades a growing body of evidence from cognitive and behavioural neuroscience has deeply questioned classical views of free will, opening an ongoing scientific debate<sup>4</sup>. Particularly, neuroscientific discov-

eries have raised the concern that decisional processes of human beings are less free than previously believed. Moreover, neuroscientists conceptualized the concept of freedom mainly as the capacity to inhibit one's behavioural urges<sup>3</sup>.

The possibility to evaluate to what extent a specific action is the result of a defendant's "free choice" is often considered the principal matter of investigation in forensic psychiatry criminal responsibility assessment<sup>5</sup>. Hence the theoretical debate on free will constitutes a topic of great interest for forensic psychiatrists as different views of free will could accordingly affect a defendant's accountability in different ways. In this sense, the concept of free will is crucial in forensic psychiatry where at present evaluations rely mainly on notions such as sense of agency, capability to do otherwise and to act for an intelligible reason. Clearly, the notions used also depend, at least in part, on the jurisdiction: different legal systems may have different standards for insanity, e.g., The M'Naghten Rule, or The Model Penal Code's standard<sup>6</sup>. In addition, the notion of free will deeply influences our ethical view of the world, and is central to the systems of law, adjudication, and punishment that inherits much of its structure from our moral views<sup>1</sup>.

In the present paper we will argue for an operationalization of "free will" in forensic psychiatric assessments of criminal responsibility, using a framework derived from decision-making competency research<sup>7</sup>. The outline of the article is as follows. First, we will briefly consider the concept of free will from a neuroscientific perspective. Specifically, we will provide an overview of the concept of free will from a neuroscientific point of view, defined as the "subject's awareness of the freedom to act". Next, we consider the concept of free will more closely, concluding that the concept is both too controversial and vague to be used in psychiatric assessments. Notably, this does not in itself mean that we conclude that free will does not exist, or that the concept is meaningless; we argue that, as such, it is not sufficiently helpful in assessments of criminal responsibility to provide guidance in this particular – yet important – context. Then, we will propose the application of the decision-making capacity model to conceptualize free will and to guide the forensic psychiatry criminal responsibility evaluation. Finally, we consider some advantages of this framework and draw conclusions.

## **FREE WILL AND NEUROSCIENCES**

In the last decades an important contribution to the debate on free will has come from neurosciences. Neuroscientists tended to ignore the traditional metaphysical perspective and focused on the role of the central nervous system in decision-making and human freedom of choice. This approach meant a radical epistemological change, since it used a brain sciences approach to advance a discussion on a theme that has long been considered the realm of philosophy.

In fact, several brain areas and circuits have been related to (elements of) free will. The brain's parietal and medial frontal lobes have been implicated in the representation of intention and in initiation of self-generated motor activity<sup>8</sup>. Pre-motor areas have been proposed to be involved in unconscious internally generated voluntary actions<sup>9-11</sup>. A first insight into the neurophysiological correlations of intentional action has been provided by a seminal study by Libet and

colleagues, which showed that the human brain begins to prepare the action before the subject becomes aware of the decision to act<sup>12</sup>.

Some insight into the study method will follow to better understand further advances as well as criticism.

The experiment implied measuring the readiness potential (RP), a slow electrical change of the EEG sequence which originated from the supplementary motor area (SMA), a cortical region which is involved in the preparation of the motor sequence, and begins, it turned out, its electrical activity half a second or more before a voluntary movement is performed<sup>13</sup>. Participants were asked to hold their gaze to an oscilloscope clock which completed its rotation in 2.56 seconds. Then, they were required to flick or flex their finger or wrist whenever they freely wanted to do so, and to report the precise moment in which they became aware of the intention to perform the action, by remembering the exact position of the clock spot (this moment was called W, because it was the expression of the conscious experience of the will). The authors found that the RP started 550 ms before the subjects became conscious of their decision to act and concluded that human actions were associated with a preconscious activity of the brain. As a consequence, it has been argued that conscious intentions are not at the origin of our voluntary behaviour; nevertheless, they arise before a movement takes place, about 150 to 200 ms before its beginning as indicated by the electromyogram (EMG)<sup>12</sup>, probably meaning that there is still time for consciousness to suppress the movement before it actually takes place<sup>14</sup>.

These findings have also been interpreted as an empirical confirmation of cerebral determinism, which postulates that every action is the unavoidable product of previous brain events, which occur following natural rules, and considered to imply that human beings are never completely free, or unconditioned, when they decide to do something, except for the possibility to inhibit their behaviour. It has been offered that Libet substituted the concept of "free will" with that of "free won't"<sup>15</sup>.

In interpreting these results one must bear in mind that the RP is present also when the participant withheld the action, thus questioning its specificity as a precursor to a voluntary action<sup>16</sup>. Moreover, Brass and Haggard<sup>17</sup> showed that the intentional inhibition of action was associated with the activation of the anterior fronto-medial cortex and of the anterior insula. Further insight into the mechanisms underlying intentional behaviour have been provided by Haggard and Eimer<sup>18</sup> who showed that conscious intentions were correlated to a lateralized RP (LRP) which reflects hand-specific motor preparation.

The existence of cerebral structures whose activation can be shown long before an action takes place was provided by Soon et al.<sup>19</sup> who found prefrontal and parietal cortex brain activity up to 10 seconds before the subject's awareness. Even though these data may not provide conclusive evidence regarding the (non)existence of free will, together such results suggest the involvement of a higher level control network in shaping an upcoming decision before it becomes conscious.

Despite the aforementioned lines of research shedding light on neural and electrophysiological correlates of intentional action and inhibition, some authors raised skepticisms and criticism<sup>20</sup>. For example, Libet's paradigm has been

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deemed not the best method to examine conscious intention of motor actions, since post hoc reconstructions strongly influence our experience of conscious decisions<sup>21</sup>. Others<sup>22,23</sup>, affirmed that Libet's Experiment is not an unambiguous demonstration of the unconscious motor preparation, because the RP represents an indicator of a movement which is considered for the future, rather than one that it is supposed to start immediately. One of the conceptual criticisms points out that results which deal with fingers or wrist can be hardly informative of complex decisions taken in the real world<sup>14,24</sup>. In addition, we believe that another limit to the generalizability of these results is represented by the neglect of the emotional component associated with making a decision and expecting its consequences. The experimental condition, in fact, does not take into account the emotionally charged situation that often characterizes the circumstances of criminal aggression.

Summarizing, neuroscience has provided data that, according to some, prove that free will is non-existent. In any case, neurosciences – and neuroscientists – have made the topic of free will more controversial. In addition, the evidence provided by neurophysiological and neuroimaging studies shows that action intention and inhibition have specific biological correlates which partly precedes the decision awareness. However, to what extent such a model could be informative and guide the evaluation of complex criminal behaviours in a forensic setting, is still a heatedly debated issue.

## **FREE WILL, THE WILL, AND MENTAL DISORDERS**

A link between freedom and mental disorders has been supposed and has survived for a long time, considering that the Fourth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) included *an important loss of freedom* as one of the possible defining features of mental disorders<sup>25</sup>. Nonetheless, DSM-5<sup>26</sup>, for unstated reasons, no longer mentions such a concept for defining psychiatric disorders and their complexity. A possible explanation of this choice relies on the idea that this *loss of freedom* is already included in the notion of disability<sup>27,28</sup>.

Nor is it clear whether the *loss of freedom* concept was referred to practical impairments or to the freedom of the mind or free will<sup>29</sup>. Psychiatric symptoms might impair decision-making, and consequently freedom, from a practical point of view (disabilities, like in somatic diseases) as well as from a psychological viewpoint: affecting the freedom of one's mind. Regarding this last aspect, mental disorders are commonly considered as being associated with compromised free will. Because of the intimate relationship between the concepts of free will and responsibility, alterations in psychiatric patients' free will could consequently reduce responsibility.

However, to our knowledge, there are no legal systems or criteria assuming lack of free will, *per se*, to be the reason for non-accountability in criminal trials. Noteworthy, free will is generally conceived in a different way from the concept of liberty or freedom which includes the absence of external coercion, conditioning and the limitation of possibilities<sup>30</sup>.

The will is not only a topic in philosophy, but certainly also in psychopathology. Aboulia, impulse control, agorapho-

bia, and obsessions have been initially conceptualized as "pathological disorders of the will"<sup>31</sup>. A defect of volition was also central to Kraepelin's notion of *dementia praecox* – the forerunner of Bleuler's schizophrenia – which he considered to be ultimately associated with a loss of will<sup>32</sup>. However, after the turn of the century interest on this topic began to decline; "the more likely explanation is that the will became a casualty of fashion, and of the anti-will view entertained by psychoanalysis and behaviourism. To its decline also contributed the anti-rationalism and pessimism that appeared in the wake of the First World War and the acceptance of mechanistic and neurological explanations for the disorders of motility (e.g. tics, forced movements, stereotypes, etc.) seen after the epidemics of encephalitis lethargica"<sup>31</sup>.

Nonetheless, in the last decades there has been a renewed interest in the concept of will, particularly free will, which has been differently described and conceptualized.

According to Walter<sup>33</sup> free will is composed of three parts. The first component is the presence of alternative possibilities: to act freely the subject must be able to act otherwise. Secondly, he must act (or choose) for an intelligible reason. Lastly, he must be the originator (causal source) of his action. All these three aspects may be compromised in mental disorders, which can undermine the possibility to choose between alternatives, affect the intentional aspect of behaviour, and alter the sense of agency<sup>29</sup>. Regarding the ability to do otherwise, the paradigmatic case is perhaps that of obsessive compulsive disorder, in which the patient is compelled to act the compulsions and has difficulty in stopping intrusive actions or thoughts, although it is usually possible for her/him to inhibit, or at least postpone, the compulsive behaviour. Therefore, a better example may be: acts influenced by a commanding auditory hallucination that cannot be disobeyed, as they may, e.g., occur in schizophrenia. In such an instance, the will is 'hijacked' by the voice that makes a patient choose a particular course of action (34), or the irrational movements of catatonia may be an example of the impairment of acting for an intelligible reason. Finally, the actions which follow a manic state probably reflect how the person cannot be considered the genuine source (originator) of the action<sup>29</sup>. In sum, based on this tripartite free will framework proposed by Walter, we can conclude that mental disorders may compromise free will –but exactly when and how they do so is not very clear, and open to interpretation.

## **FREE WILL, CRIMINAL RESPONSIBILITY AND DECISION-MAKING CAPACITY**

Based on our analysis so far, we can conclude that, firstly, compromised free will is often considered central to legal insanity, and, secondly, free will may indeed be affected by mental illness. But does this render free will a helpful concept in actual psychiatric assessments of criminal responsibility? We don't feel this is the case. Firstly, the very existence of free will is contested by, among others, neuroscientists, using arguments that are, e.g., based on Libet-style experiments. Secondly, although the notion of free will can be related to mental disorders, as was shown using Walter's tripartite framework, the concept – and how exactly it is related to psychopathology – remains vague. Thirdly, although

free will is often informally used as a criterion for criminal responsibility, it is not reflected in legal insanity standards such as M'Naghten. For instance, in the United States, to date there is no legal criteria which include the absence of free will as a prerequisite to reduced responsibility and accountability. As a consequence, some authors argue that the law does not at all require "free will" for holding a person responsible for their criminal act<sup>35</sup>. To overcome the various problems related to using free will regarding legal insanity, it has been proposed to substitute the concept of free will with the concept of autonomy<sup>36</sup>. Based on this proposal, it has been suggested to compare the forensic evaluation for criminal responsibility to the medical assessment of decisional capacity performed during the evaluation of patients' competence to consent to treatment<sup>7</sup>. The reason is that the central concept in patient decision-making competency is *autonomy*.

There are several advantages of using the concept of decision-making (competency) instead of free will. Firstly, whereas free will is considered "problematic" from a neuroscientific perspective, decision-making is a concept often used in cognitive neuroscience research<sup>37</sup>. For example, decision making, which can be conceptualized as the ability to select one course of action among several possible options, relies on frontal lobes functioning<sup>38</sup>. Specifically, it has been suggested that the orbital sector is responsible for the affective value of the stimulus, the medial sector controls the motivation to act, while the lateral sector supervises the higher-order cognitive structure of plans and goals<sup>38</sup>.

A second advantage is that the concept of free choice has also been used to explain competent decision-making<sup>39</sup>. Therefore, competent decision-making could be understood as a way of "operationalizing" free choice within the context of patient's decision-making about treatment options. This should not surprise us, as the philosopher Al Mele writes: «Autonomy, as I understand it, is associated with a family of freedom-concepts: free will, free choice, free action and the like»<sup>39</sup>. In this line of thought, competent patient decision-making can be conceived of in terms of autonomy, but also in terms of free choice and free will.

Thirdly, medical assessment of decisional capacity research has been widely studied across jurisdictions (which cannot be said of legal standards on insanity, at least not to the same degree), in particular with respect to mental illness<sup>40-43</sup>. Among possible factors associated with impaired decision making, is cognitive dysfunction, which has been widely acknowledged to play a major role both in psychiatric<sup>44-47</sup>, and nonpsychiatric<sup>48</sup> samples. In addition, specific groups of psychiatric patients, such as those affected by schizophrenia, have been considered particularly at risk from impaired decision making<sup>49-52</sup> in spite of a considerable heterogeneity having been acknowledged within diagnostic groups<sup>43,53-55</sup>. Finally, the severity of psychiatric symptoms<sup>56-58</sup>, impaired metacognition<sup>59</sup> and multiple environmental factors<sup>60,61</sup>, such as the complexity of the disclosed information, the type of clinical setting, and the quality of consent forms and disclosing procedures, have been acknowledged to affect patients' decisional capacity. It would be a very positive development if research, as it has been done on patient competency using this model, could also be performed on insanity defense evaluations in the future – clearly, some adaptations to the model would have to be made to make it fit the forensic context, see below.

Interestingly, a clinical tool has been developed to assess patients' decisional capacity, the MacArthur Competence Assessment Tool for Treatment (MacCAT-T)<sup>50</sup>. This is a semi-structured interview relying on a multidimensional capacity model and it assesses four abilities; a) the patients' comprehension about the disorder's main features and specific treatment, including potential risks and benefits; b) the patients' ability to acknowledge her/his medical condition and likely consequences of treatment options; c) the patients' ability to manipulate the disclosed information about diagnosis in a rational and logical way, reasoning about possible everyday effects of treatments, and comparing different treatment options; d) the patients' ability to take and communicate a treatment-related decision in a clear and consistent way.

Notably, this fourpartite model has not only been studied but also applied across many jurisdictions, in fact, even though its origins are American, it has become an 'international' framework for competency assessments, making a fruitful exchange of experiences and ideas across nations and legal systems possible. In our view, this is one of the most interesting features of this model<sup>62</sup>.

## CONTEXTUALIZING THE MODEL

We believe that the model of competence to consent to treatment, which is a clinical one, could provide a suitable framework to operationalize "free will" in a sense which can be relevant for the mental insanity assessment<sup>7</sup>). Hopefully, using this theoretical but also practical model in insanity assessments will enable the exchange of ideas in research across jurisdictions and disciplines, just like what happened regarding capacity to consent assessments. Yet, the model has to be contextualized regarding the specific situation of forensic assessments of criminal responsibility. In fact, there are several differences between evaluations of incompetence and insanity as well, which should be recognized. Firstly, the assessment of criminal responsibility involves a retrospective evaluation (the "state of mind at the time of the criminal act"), while the evaluation of competence to consent regards a decision which has to be made at the moment or in the immediate future<sup>63</sup>. Secondly, forensic evaluations deal with a criminal act and are performed in a juridical environment, while informed consent acquisition is related to choosing about a treatment in a medical setting; thirdly, the forensic assessment aim is to ascertain that the subject can be held accountable, or responsible, for the act, while the medical evaluation focuses on the patient autonomy regarding his/her treatment decisions – autonomy and accountability being related, though not identical. Finally, the mental insanity assessment relates to an act, which is unlawful and could be punishable, while informed consent acquisition deals with a choice about a medical treatment, which is legal and admissible<sup>63-64</sup>.

Despite these limitations, some similarities between these two models must be acknowledged (which, in part, depend on the specific standard and regulations in a legal system). Firstly, both assessments concern a *normative* evaluation by a health professional of a *particular* act/choice by an individual. Secondly, in practice, in both assessments the decision making process is evaluated in relation to the possible pres-

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ence and influence of a mental disorder, or, more broadly, mental incapacity<sup>63</sup>. In the first case, in fact, competence to consent to treatment must be verified as a prerequisite of valid informed consent acquisition, while in the second case forensic psychiatrists must investigate if the defendant possessed the capacity to appreciate the wrongfulness of the act and if the presence of a mental disorder influenced the decision making process that led to the act<sup>63</sup>. Thirdly, as the patient (to be considered capable to consent to treatment) must understand his/her diagnosis, treatment and risks and benefits, so the defendant (to be held accountable for the crime) must demonstrate his/her ability at the moment of the crime to have comprehended the situation, and any relevant information. Fourthly, the patient must possess the ability to acknowledge his/her medical condition and likely consequences of treatment options; similarly the defendant must show to have acknowledged his options or alternative possibilities. As the patient must be able to manipulate the disclosed information and make assumptions on possible everyday effects of treatments, and compare different treatment alternatives, the defendant should demonstrate to have processed information about his/her options and their possible consequences. Finally, while the patient must be able to make a choice about his/her treatment and express it in a clear and consistent way, the defendant must have possessed the ability to perform or inhibit one's behaviour (at least in those jurisdictions in which the insanity standard includes a control prong).

Based on the relevant similarities, we believe that the clinical model of competence to consent to treatment could provide a suitable framework to conceptualize and contextualize the notion of free will in forensic insanity assessments.

In addition, in our view, the neuroscientific model of free will could be useful mainly to support evidence regarding deficits in the inhibitory control, while currently, it may provide less information on how the presence of a mental disorder could have affected the defendant's capacity to comprehend the situation, appreciate his/her options and reason about their possible consequences at the moment of the crime. Yet, there are cases where neuroscience may also pro-

vide information regarding these issues, e.g., brain imaging in dementia, a disorder that may also sometimes can lead to criminal behaviour. See table 1 for neurocognitive dimensions related to the four capacities, which can, in principle, also be assessed by neurocognitive evaluations, and further clarified by neurocognitive research.

**CONCLUSIONS**

The philosophical debate about free will is far from being concluded. A crucial question to be addressed is if the problem of free will should constitute an issue for forensic psychiatrists. Apparently, the concept expresses something central in assessment of criminal responsibility or legal insanity. Yet, in our opinion, the concept of free will as such is too vague and too controversial to be helpful to guide actual assessments of criminal responsibility. Still, the concept could be operationalized and contextualized in terms of (autonomous) decision-making, which could well be useful for analyzing human behaviour. More specifically, the retrospective application of a model assessing the decisional mental capacity processes could provide a helpful framework for the assessment of the defendant's accountability. The proposed framework is not just compatible with neuroscience, the evaluation of the components of decision-making can be informed by a growing body of neuroscientific data; in contrast to free will, decision-making is a term often used and studied in cognitive neuroscience. This makes it possible to perform assessments that are supported by neuroscientific views and findings. The decisional capacity evaluation should be based on criminal and clinical data together with the elements related to the trial, despite the mentioned limitations associated with its application in the forensic setting.

There are various possible approaches to assessments of a defendant's insanity, also depending on the jurisdiction. Yet, in general, in insanity evaluations, it is relevant to examine a defendant's choices about courses of action at the time of the crime. A fourpartite model to evaluate autonomous choice, as used in assessments of competence, can be adapted to the

Table 1. Decisional capacity, clinical and forensic dimensions (for references, see text).

	Clinical	Forensic	Neuropsychological dimensions
Understanding	Diagnosis Therapy	Wrongfulness of the act: legal and moral aspects of the act	Attention - Concentration Perception Language Memory - Learning
Appreciating	Diagnosis Therapy	The nature of and possible options in the situation (e.g., in terms of threat, danger, risks)	Comparison Emotions Information processing, in particular reality testing Motivation
Reasoning	Consequential thinking Comparative thinking Generating consequences Logical coherence	Consequential thinking Comparative thinking Generating consequences Logical coherence	Executive functions: Abstract thinking Working memory Problem solving Cognitive flexibility
Expressing a choice	In a clear and consistent way	Ability to perform an action or to inhibit one's behavior	Motility Associative areas

specific context of such evaluations. We have argued that the application of this model to evaluate decision-making in the forensic context will be informative on how the manifestations of a mental disorder could have affected the defendant's capacity to understand the wrongfulness of the situation, acknowledge his/her options and reason about possible consequences of his/her action at the moment of the crime. These aspects, in fact, are extremely important to shed light on the defendant's "state of mind" at the time of the act and to consequently assess his/her accountability.

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## REFERENCES

1. Grim P. Free will in context: a contemporary philosophical perspective. *Behav Sci Law* 2007; 25: 183-201.
2. Rigoni D, Sammicheli L, Brass M. Perspectives of the experience of will. *HumanaMente* 2011; 15: 139-58.
3. De Caro M, Lavazza A, Sartori G. Siamo davvero liberi? Le neuroscienze e il mistero del libero arbitrio [Are we really free? Neuroscience and the mystery of free will]. Torino: Codice Edizioni, 2010.
4. Cary P. A brief history of the concept of free will: issues that are and are not germane to legal reasoning. *Behav Sci Law* 2007; 25: 165-81.
5. Baumeister RF, Masicampo EJ, Dewall CN. Prosocial benefits of feeling free: disbelief in free will increases aggression and reduces helpfulness. *Pers Soc Psychol Bull* 2009; 35: 260-8.
6. Simon RJ, Ahn-Redding H. The insanity defense, the world over. Lanham, MD: Lexington Books; 2006.
7. Meynen G. Autonomy, criminal responsibility, and competence. *J Am Acad Psychiatry Law* 2011; 39: 231-6.
8. Fried I, Mukamel R, Kreiman G. Internally generated preactivation of single neurons in human medial frontal cortex predicts volition. *Neuron* 2011; 69: 548-62.
9. Brass M, Haggard P. The what, when, whether model of intentional action. *Neuroscientist* 2008; 14: 319-25.
10. Desmurget M, Sirigu A. A parietal-premotor network for movement intention and motor awareness. *Trends Cogn Sci* 2009; 13: 411-9.
11. Haggard P. Human volition: towards a neuroscience of will. *Nat Rev Neurosci* 2008; 9: 934-46.
12. Libet B, Gleason CA, Wright EW, Pearl DK. Time of conscious intention to act in relation to onset of cerebral activity (readiness-potential). The unconscious initiation of freely voluntary act. *Brain* 1983; 106: 623-42.
13. Gomes G. Free will, the self, and the brain. *Behav Sci Law* 2007; 25: 221-34.
14. Pockett S. The concept of free will: philosophy, neuroscience and the law. *Behav Sci Law* 2007; 25: 281-93.
15. Dennet D. *Freedom Evolves*. London: Penguin, 2003.
16. Libet B, Wright EW, Gleason CA. Preparation- or intention-to-act, in relation to pre-event potentials recorded at the vertex. *Electroencephalogr Clin Neurophysiol* 1983; 56: 367-72.
17. Brass M, Haggard P. To do or not to do: the neural signature of self-control. *J Neurosci* 2007; 27: 9141-5.
18. Haggard P, Eimer M. On the relation between brain potentials and the awareness of voluntary movements. *Exp Brain Res* 1999; 126: 128-33.
19. Soon CS, Brass M, Heinze HJ, Haynes JD. Unconscious determinants of free decisions in the human brain. *Nat Neurosci* 2008; 11: 543-5.
20. Radder H, Meynen G. Does the brain "initiate" freely willed processes? A philosophy of science critique of Libet-type experiments and their interpretation. *Theory & Psychology* 2012; 23: 3-21.
21. Rigoni D, Brass M, Sartori G. Post-action determinants of the reported time of conscious intentions. *Front Hum Neurosci* 2010; 4: 38.
22. Trevena JA, Miller J. Cortical movement preparation before and after a conscious decision to move. *Conscious Cogn* 2002; 11: 162-90.
23. Trevena J, Miller J. Brain preparation before a voluntary action: evidence against unconscious movement initiation. *Conscious Cogn* 2010; 19: 447-56.
24. Klemm WR. Free will debates: simple experiments are not so simple. *Adv Cogn Psychol* 2010; 6: 47-65.
25. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Washington, DC: American Psychiatric Association (text rev.), 2000.
26. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Washington, DC: American Psychiatric Association, 2013.
27. First MB, Wakefield JC. Defining "mental disorder" in DSM-V. A commentary on: "What is a mental/psychiatric disorder? From DSM-IV to DSM-V" by Stein et al. (2010). *Psychol Med* 2010; 40: 1779-82; discussion 931-4.
28. Stein DJ, Phillips KA, Bolton D, Fulford KW, Sadler JZ, Kendler KS. What is a mental/psychiatric disorder? From DSM-IV to DSM-V. *Psychol Med* 2010; 40: 1759-65.
29. Meynen G. Free will and mental disorder: exploring the relationship. *Theor Med Bioeth* 2010; 31: 429-43.
30. Lavazza A, Sammicheli L. *Il delitto del cervello. La mente tra scienza e diritto* [The brain's crime]. Torino: Codice Edizioni, 2012.
31. Berrios GE. *The history of mental symptoms: descriptive psychopathology since the 19th century*. Cambridge: Cambridge University Press, 1996.
32. Henderson S. The neglect of volition. *Br J Psychiatry* 2005; 186: 273-4.
33. Walter H. *Neurophilosophy of free will: from libertarian illusions to a concept of natural autonomy*. Cambridge: MIT Press, 2001.
34. Meynen G. How mental disorders can compromise the will. In: Glannon W (ed). *Free will and the brain. Neuroscientific, philosophical, and legal perspectives*. Cambridge: Cambridge University Press, 2015.
35. Morse SJ. The non-problem of free will in forensic psychiatry and psychology. *Behav Sci Law* 2007; 25: 203-20.
36. Juth N, Lorentzon F. The concept of free will and forensic psychiatry. *Int J Law Psychiatry* 2010; 33: 1-6.
37. Meynen G. A neurolaw perspective on psychiatric assessments of criminal responsibility: decision-making, mental disorder, and the brain. *Int J Law Psychiatry* 2013; 36: 93-9.
38. Gazzaniga MS. *The cognitive neurosciences*, 4th Edition. Cambridge: MIT Press, 2009.
39. Meynen G. Free will and psychiatric assessments of criminal responsibility: a parallel with informed consent. *Med Health Care Philos* 2010; 13: 313-20.
40. Appelbaum PS. Clinical practice. Assessment of patients' competence to consent to treatment. *N Engl J Med* 2007; 357: 1834-40.
41. Cairns R, Maddock C, Buchanan A, et al. Reliability of mental capacity assessments in psychiatric in-patients. *Br J Psychiatry* 2005; 187: 372-8.
42. Owen GS, David AS, Richardson G, Szmukler G, Hayward P, Ho-topf M. Mental capacity, diagnosis and insight in psychiatric in-patients: a cross-sectional study. *Psychol Med* 2009; 39: 1389-98.
43. Palmer BW, Dunn LB, Appelbaum P, Jeste D. Correlates of treatment-related decision-making capacity among middle-aged and older patients with schizophrenia. *Arch Gen Psychiatry* 2004; 61: 230-6.
44. Dunn LB, Palmer BW, Appelbaum PS, Saks ER, Aarons GA, Jeste DV. Prevalence and correlates of adequate performance on

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- a measure of abilities related to decisional capacity: differences among three standards for the MacCAT-CR in patients with schizophrenia. *Schizophr Res* 2007; 89: 110-8.
45. Mandarelli G, Parmigiani G, Tarsitani L, Frati P, Biondi M, Ferracuti S. The relationship between executive functions and capacity to consent to treatment in acute psychiatric hospitalization. *J Empir Res Hum Res Ethics* 2012; 7: 63-70.
  46. Palmer BW, Jeste DV. Relationship of individual cognitive abilities to specific components of decisional capacity among middle-aged and older patients with schizophrenia. *Schizophr Bull* 2006; 32: 98-106.
  47. Palmer BW, Dunn LB, Depp CA, Eyler LT, Jeste D. Decisional capacity to consent to research among patients with bipolar disorder: comparison with schizophrenia patients and healthy subjects. *J Clin Psychiatry* 2007; 68: 689-96.
  48. Raymont V, Bingley W, Buchanan A, et al. Prevalence of mental incapacity in medical inpatients and associated risk factors: cross-sectional study. *Lancet* 2004; 364: 1421-7.
  49. Carpenter WT, Gold JM, Lahti AC, et al. Decisional capacity for informed consent in schizophrenia research. *Arch Gen Psychiatry* 2000; 57: 533-8.
  50. Grisso T, Appelbaum P, Hill-Fotouhi C. The MacCAT-T: a clinical tool to assess patients' capacities to make treatment decisions. *Psychiatr Serv* 1997; 48: 1415-9.
  51. Kovnick J, Appelbaum P, Hoge S, Leadbetter R. Competence to consent to research among long-stay inpatients with chronic schizophrenia. *Psychiatr Serv* 2003; 54: 1247-52.
  52. Moser DJ, Schultz SK, Arndt S, et al. Capacity to provide informed consent for participation in schizophrenia and HIV research. *AJ Psychiatry* 2002; 159: 1201-7.
  53. Appelbaum PS. Decisional capacity of patients with schizophrenia to consent to research: taking stock. *Schizophr Bull* 2006; 32: 22-5.
  54. Dunn LB. Capacity to consent to research in schizophrenia: the expanding evidence base. *Behav Sci Law* 2006; 24: 431-45.
  55. Jeste DV, Depp CA, Palmer BW. Magnitude of impairment in decisional capacity in people with schizophrenia compared to normal subjects: an overview. *Schizophr Bull* 2006; 32: 121-8.
  56. Howe V, Foister K, Jenkins K, Skene L, Copolov D, Keks N. Competence to give informed consent in acute psychosis is associated with symptoms rather than diagnosis. *Schizophr Res* 2005; 77: 211-4.
  57. Mandarelli G, Tarsitani L, Parmigiani G, et al. Mental capacity in patients involuntarily or voluntarily receiving psychiatric treatment for an acute mental disorder. *J Forensic Sci* 2014; 59: 1002-7.
  58. Parmigiani G, Mandarelli G, Dacquino C, Pompili P, Lelli Chiesa G, Ferracuti S. Decisional Capacity to Consent to Clinical Research Involving Placebo in Psychiatric Patients. *J Forensic Sci* 2016; 61: 388-93.
  59. Koren D, Poyurovsky M, Seidman LJ, Goldsmith M, Wenger S, Klein EM. The neuropsychological basis of competence to consent in first-episode schizophrenia: a pilot metacognitive study. *Biol Psychiatry* 2005; 57: 609-16.
  60. Jeste D, Palmer BW, Appelbaum P, et al. A new brief instrument for assessing decisional capacity for clinical research. *Arch Gen Psychiatry* 2007; 64: 966-74.
  61. Palmer BW. Informed consent for schizophrenia research: what is an investigator (or IRB) to do? *Behav Sci Law* 2006; 24: 447-52.
  62. Meynen G, Oei K. Internationalizing forensic assessments of criminal responsibility. *Med Law* 2011; 30: 529-34.
  63. Meynen G. Exploring the similarities and differences between medical assessments of competence and criminal responsibility. *Med Health Care Philos* 2009; 12: 443-51.
  64. Meynen G. *Legal insanity: explorations in psychiatry, law, and ethics*. Springer International Publishing, 2016.