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Operationalizing and Measuring (a Kind of) Free Will (and Responsibility). Towards a New Framework for Psychology, Ethics, and Law

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Abstract Free will is usually defined by three conditions: (1) the ability to do otherwise; (2) control of one's own choices; (3) responsiveness to reasons. The compatibility of free will with determinism lies at the heart of the philosophical debate at the metaphysical level. This debate, while being increasingly refined, has not yet reached a conclusion. Recently, neuroscience and empirical psychology have tried to settle the problem of free will with a series of experiments that go in the direction of so-called illusionism: free will as the conscious control of our behavior cannot exist, being a mere illusion. But even in this case, the experimental results are challenged at various levels. Considering that in most moral and legal systems, the subject's liability derives from their freedom, the usefulness of preserving the concept of freedom – which incidentally responds to a very strong commonsensical intuition – suggests the need for an operational solution. This could be done by resorting to the concepts of capacity and cognitive control, which are measured by a set of well-established neuropsychological tests. Our preliminary proposal is to create an index, the first step towards a specific quantification and measurement of free will, to be used especially in ethical and legal contexts.
KEYWORDS: Free Will; Responsibility; Self-control; Cognitive Functions; Determinism/Compatibilism.

Riassunto *Operazionalizzare e misurare (un tipo di) libero arbitrio (e di responsabilità). Un nuovo quadro di riferimento per la psicologia, l'etica e il diritto* – Il libero arbitrio è solitamente definito da tre condizioni: (1) la possibilità di fare altrimenti; (2) il controllo delle proprie scelte; (3) la sensibilità alle ragioni. L'esistenza del libero arbitrio rispetto alla verità del determinismo è il cuore del dibattito filosofico a livello metafisico. E tale dibattito, pur sempre più raffinato, non ha ancora raggiunto un punto di approdo. Recentemente, le neuroscienze e la psicologia empirica hanno cercato di dirimere il problema del libero arbitrio con una serie di esperimenti che vanno nella direzione del cosiddetto illusionismo. In altre parole, il libero arbitrio come controllo cosciente del nostro comportamento non esisterebbe. Anche in questo caso, però, i risultati sperimentali sono sfidati a vari livelli. Considerato che dalla libertà discende, in gran parte dei sistemi morali e legali, la responsabilità degli individui, l'utilità di conservare il concetto di libertà, verso la cui esistenza c'è anche una forte intuizione tra i non esperti, suggerisce di circoscrivere e operazionalizzare il libero arbitrio. Ciò potrebbe essere fatto ricorrendo alle nozioni di capacità e controllo cognitivo, che sono misurati da una serie di test neuropsicologici ben consolidati. La proposta preliminare è quella di creare un indice sintetico, primo passo verso una specifica quantificazione e misurazione del libero arbitrio di cui siamo dotati, da utilizzare soprattutto in ambito etico e giuridico.
PAROLE CHIAVE: Libero arbitrio; Responsabilità; Autocontrollo; Funzioni cognitive; Determinismo/Compatibilismo.

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Introduction

FREE WILL HAS BEEN A controversial issue that philosophers have debated for centuries without ever finding a definitive solution.[1] At first sight, the philosophical discussion on freedom may not seem to be relevant to people's everyday lives, but upon closer inspection, it is. In fact, free will can be the reason why someone is not sent to jail during a trial due to an appeal of insanity: the subject was not "free" when they committed the crime, not because someone was pointing a gun to their head, but because a psychiatric illness prevented them from controlling their actions. According to a long philosophical tradition that goes from Aristotle to Kant and Hegel, if someone was not "free" when they did something, they cannot be held responsible for their deed.[2] And the freedom in question is both "social" freedom (linked to constraints imposed by our peers or external circumstances), and the freedom designated by the specific term *free will*.

Free will is usually qualified by three conditions. The first condition is the "ability to do otherwise". How could we call ourselves free if we did not have an opportunity to choose between two or more courses of action, or to make a certain choice or not?

If we have an eye tic, we are not in a position to choose whether or not to wink. The second condition is having "control over our choices". We must be the ones to decide what to do; in order to be free, we need to be the ones making choices; not other people or mechanisms beyond our reach. It is what is called being and feeling like an "agent". The third condition is "responsiveness to reasons": what makes a choice free is that it is not random, but rationally motivated. If I flip a coin to decide whom to marry, mine won't be regarded as a truly free choice, despite the fact that I will freely turn up at the altar. On the contrary, if I choose to marry someone for their qualities, their compatibility and our mutual feelings, then my choice is free.

The kind of freedom identified through these conditions is what we usually think we possess and that we intuitively attribute to others, excepting seriously ill people or people under the effects of psychotropic substances, from alcohol to synthetic drugs.[3] This does not mean, of course, that all our choices are characterized as being "free" in the full sense expressed by the "ability to do otherwise", "control" and "responsiveness to reasons". We often act on impulse, against our interests, without being fully aware. But this does not imply that we are not potentially able to act freely. Ethics and the law have incorporated these notions, considering that usually people are free to act or not to act in a certain way and that, as a result, they are responsible for what they do, with the exceptions mentioned above.[4]

Obviously, none of the above conditions is immune to complications or difficulties. There is no unanimous agreement on them or on their definition. However, for a long time they have seemed sufficient to draw a not only theoretical but also pragmatic picture of the concept of free will and its recognition in human actions. Understanding if human actions are free is one of the prerequisites of ethics and law and is also one of the goals of psychological research, which deals with the actions and motives of the individual. But the recent role of science in the philosophical research on free will is not, at present at least, helping ethics and law to settle disputes about freedom. This leads us to take a different path in the hope of overcoming subjective evaluations and reaching more shared conclusions, based on theoretically framed data. The matter, however, is complex and controversial both theoretically and epistemologically.

For this reason, before presenting our entirely preliminary proposal for the operationalization and measurement of a certain kind of free will, it is necessary to carry out a number of considerations and clarifications.

Different kinds of free will

The first, great and permanent challenge to free will has been determinism.[5] Determinism is the view that everything that happens

(including human choices and actions) is the product of the sufficient conditions for its occurrence. More specifically, it is the argument that all mental phenomena and actions are also, directly or indirectly, causally produced – according to the laws of nature (such as those of physics and neurobiology) – by previous events that lie beyond the control of the agents. As is known, this caused the crystallization of well-defined positions in philosophy, while over time no substantial progress was made toward a shared thesis. Philosophical inquiry has certainly refined itself and new arguments were brought forward on several fronts, but none seems decisive yet on a theoretical level.

The belief in determinism leads to denying the reality despite the appearance of human freedom: this is the case of those who call themselves hard determinists.[6] If determinism is incompatible with freedom, then they believe that freedom must be eliminated. Incompatibilists include also libertarians, who, even when faced with the evidence of human freedom, believe that determinism is not the ultimate answer when it comes to human affairs, and that therefore there is space for free decisions, or at least decisions caused by the subject.[7]

Compatibilists, on the other hand, consider that determinism and freedom are not contradictory if you properly specify the concept of freedom: we are not beings *causa sui*, self-caused beings, but we can act according to our will. Our desires, however, cannot escape the general causal chains that determinism implies.[8] The subjective evidence of freedom leads compatibilists to somewhat restrict the idea of freedom without abandoning it, and at the same time to endorse determinism, which seems to be a metaphysical truth for which science provides solid and consistent inductive confirmations (with the notable and debated exception of quantum physics). These philosophical positions have influenced some moral systems, but have not substantially affected the common perception of being free in the sense of being generally able to choose between alternative courses of action following one's own will, nor have they reduced the attribution of such freedom to others.

It follows that modern penal systems were mostly built around the assumption, often implicit, that the subjects of the law are free until proven guilty, and *as* free agents are responsible for their actions. Insofar as they are responsible for their actions, they are also punishable when they violate the law.[9] Law as it was classically encoded, however, hides potential problems and contradictions about freedom and, accordingly, about responsibility. And this is an important point for our operational proposal.

In fact, law assumes that subjects are endowed with a somewhat libertarian freedom, but it cannot refute determinism in the general interpretation of reality, with respect to everything related to the physical environment and the material conditions in which legally relevant events take place. In this sense, the law is forced to support *de facto* a human exceptionalism that today science questions in several respects. In addition, the law itself takes account of the circumstances in which the subject / defendant is not considered fully free, both for constraints concerning so-called "social" freedom and due to organic and mental factors, which is what interests us here.[10] It would be however too complex to tackle here the original distinction between organic and mental diseases, which could also assume a residual dualism between mind and body.

What is relevant to this paper is that today, in Western legal systems, insanity is regarded as a result of behavioral evidence, which is more and more often reflected by an imbalance or an injury that affected the subject's brain and therefore his or her mental functioning. But many ambiguities and difficulties remain in the diagnosis of mental illness, and also in the codes themselves. The strictly philosophical framework outlined above has recently been affected by scientific research on the functioning of the human

brain, which has made extraordinary progress thanks to new techniques of investigation, such as the electroencephalogram and brain imaging. The scope of free will has also been tackled by empirical research, although much of the theoretical reflection has stayed closely metaphysical and, therefore, extraneous to the use of experimental methods and empirical data.

Neuroscience and free will

As is known, the most important line of study, also because of its influence on public opinion, was that inaugurated by Benjamin Libet on the role of conscious intentions in decisions considered free and voluntary.[11] The discussion on the concepts involved – from "conscious intentions" to "voluntary decisions" and "free decisions" – is open and marked by conflicting positions, and the experiments conducted have raised objections of various kinds.[12] However, the findings have been replicated and confirmed to the point that they can be said to have sufficient reliability. In his experiments, Libet invited participants to move their right wrist and, simultaneously, to report the precise moment when they had the impression that they decided to do so. In this way, it was possible to estimate the time of awareness with respect to the beginning of the movement, measured using an electromyogram (which records the muscle contraction).

During the execution of the task, brain electrical activity was recorded through electrodes placed on the scalp. Attention focused on a specific electrical brain potential, the "readiness potential". It is visible in the EEG signal as a wave that begins before any voluntary movement, while it is absent or reduced before involuntary and automatic movements. The counterintuitive and, according to many, revolutionary result emerged from a comparison of the subjective "time" of decision and the brain's. In fact, the experiment showed that the readiness potential culminating in the execution of the movement begins in the prefrontal motor areas of the brain long before the time when the subject seems to have made the decision: the volunteers became aware of the intention to take action about 500 milliseconds after the onset of such potential. The volitional process therefore seems to start unconsciously. These studies seem to indicate, in short, that our actions (or, at least, those tested) are caused by the activity of the brain and reach consciousness only at a later time.

Another observation by Libet has attracted great attention. Indeed, he noted that, once aware of the intention, the person still has a frame of time in which to inhibit movement. In essence, freedom is reduced from free will to "free won't", that is, the ability to stop what was planned unconsciously.[13] We cannot give rise to free actions, but we have the opportunity to "resist temptation". Both inferences drawn from laboratory tests are open to severe criticism. In particular, freedom of inhibit, as it was called, according to further study seems to respond to the same mechanisms as action – therefore being exposed to the same risk of illusion.[14]

More recently, studying the activity of an area of the frontal lobe, other neuroscientists of the group coordinated by John-Dylan Haynes have been able to see the "rise" of a behavioral or abstract choice (to move a hand; to add or subtract two numbers) a few seconds before the subject acquires awareness of it. The brain has already "decided" which hand to move or which arithmetic operation to perform when in the subject's awareness the decision is still far from mature.[15] If scholars, "looking" into our brains with functional magnetic resonance imaging, may provide a good approximation of a few simple choices before we are aware of them. This seems to revive the same foreknowledge issue that, when attributed to God, forced theologians to wonder whether man can be truly free, if his future is already known to someone.

There are various interpretations of these relevant experiments. First, it seems that, in some way, determinism can be observed di-

rectly within ourselves.[16] In this sense, there would be nothing more than a pure illusion of freedom. This would happen because the conception of human freedom as *causa sui* (the cause of itself, or the ability to consciously initiate new causal chains), which is implicitly part of the naive intuition of our ability to act freely, is denied by determinism by its own definition. There are causal chains that began before our birth, to which we belong and from which we cannot escape.

But determinism is a metaphysical thesis, which cannot be definitely proven with scientific evidence. The human being is subject to the immutable laws of physics, but biology is more probabilistic than deterministic and therefore the argument as sketched above does not force us to give up the idea of freedom. In fact, the fact that the brain is what initiates actions in response to environmental stimuli can configure a kind of automatism, but it doesn't imply a strict determinism *per se*. (It can still be noted in passing that if we do not want to endorse determinism, we must still be careful about the implications of indeterminism on free will. In fact, if the effects do not invariably follow from their causes, our behavior risks being random as if every time we flipped a coin to decide what to do, and we could not plan our actions according to the consequences foreseen).

Second, and most important, the role of consciousness in causing voluntary behaviour is questioned. The time lag between the start of the brain mechanisms that govern, for example, the movement of the hand and the awareness of wanting to bend the wrist or push a button with the right index finger or with the left one would indicate that consciousness "comes after", when "things are done".[17] In other words, consciousness would not lie at the origin of our voluntary choices. This, of course, stems from the very definition of free will, in which consciousness plays a key role. And this also emerges from empirical research in psychology, which does not need to study the brain *in vivo*, but is limited to ascertaining how mental phenomena really occur and not how they seem to happen to the subject through introspection. There is much evidence that, at least in some experimental situations, our behavior is affected by environmental cues of which we are unaware, acting through the mechanism of priming.[18]

Therefore, it seems reasonable to assume that our minds work and take decisions without our conscious supervision. As proposed by the psychologist Daniel Wegner, we are made in order to have *the impression* of controlling our actions; in most cases we seem to be free agents causing finalized behavior at will, but, according to Wegner, this does not actually happen.[19] Such a radical hypothesis says that we act "mechanically", led by automatic and unconscious cognitive processes, which we discover only through scientific study.

Consciousness, the main agent of free will, which should exercise control and assess the reasons for a choice, is thus allegedly causally ineffective: a mere epiphenomenon, in the terminology of the philosophy of mind. This is what has been called the *Zombie Challenge*,

> based on an amazing wealth of findings in recent cognitive science that demonstrate the surprising ways in which our everyday behavior is controlled by automatic processes that unfold in the complete absence of consciousness.[20]

This is currently the greatest empirical challenge to the ordinary concept of freedom.

Are we free?

However, it should be noted that the Libet-like experiments have been criticized with some effectiveness and this prevents one from accepting their results in a definitive way. In short, to begin with, the choice of bending the wrist now or in a few seconds is not a real choice, as it is rather irrelevant to the subject.

The indifference of the task is associated with the fact that even if the decisions taken

during the experiment are unconscious, it doesn't have to follow that all the decisions we take in our lives should be such. As noted by Mele, it can be argued that the activation of the readiness potential is not the real beginning of the action, but that an additional and subsequent triggering is required.[21]

There are also situations thoroughly tested where a decision, consciously taken, to perform an action after some time makes it so that the subjects are much more likely to actually stick to their decision: therefore, conscious reflection seems to play a significant role.

Finally, if conscious reasoning plays a role in the decision, it should not be so important that there is a small gap of hundredths of a second between the physical start of the action and the awareness of it. According to Mele, two forms of free will can be distinguished. So-called *modest free will* is defined as follows:

> having the ability to make – and act on the basis of – rational, informed decisions when you're not being subjected to undue forces is sufficient for having free will.[22]

Ambitious free will results instead from adding *deep openness* to modest free will. In this case,

> free agents have open to them alternative decisions that are compatible with everything that has already happened and with the laws of nature.[23]

This freedom remains an open option, so there is no definitive evidence either positively or negatively. Obviously, taking rational, informed decisions implies that consciousness plays a role, which is exactly what is being questioned by the zombie challenge. In this scenario, the position taken by the so-called illusionists or even "willusionists" has become popular.

There is no longer, or only, the challenge of determinism in the classical sense, but there is the disappearance of the very role of consciousness, which seems to threaten the ordinary idea of freedom based on experimental results. For if determinism is an unprovable metaphysical thesis, the conscious part of the decision-making is something you can evaluate experimentally with increasing precision.

However, there are various arguments stating that the illusionist challenge is not definitive. As we have seen, the fact that automatic, nonconscious processes are the direct causes of action seems now well established and has dealt a severe blow to some theories of conscious free will. But new theories of action have separated the deciding from the initiating, so that free conscious choosing may still play a main role in the deciding (deliberative) stage.

In other words, free will would have more to do with deciding (now) to walk to the store when the rain stops (later) than with directing each footstep during the actual trip. Modern research methods and technology have emphasized slicing behavior into milliseconds, but these advances may paradoxically conceal the important role of conscious choice, which is mainly seen at the macro level.[24]

A specific kind of free will

What we face is thus a fragmented framework in which orientation is complicated. The fact remains that in the moral and legal spheres the freedom-responsibility bond remains strong, binding moral judgment and criminal law together. Now, so-called experimental philosophy has begun to explore in greater detail the insights of non-philosophers and neuroscientists on free will and deterministic scenarios.[25]

The results are not all consistent, but it still emerges, contrary to the common belief that people are naturally libertarian, that the allocation of freedom persists even when determinism is explicitly stated, so that the participants endorse some form of naive compatibilism. A conceptualization of free will

that tries to free itself from both the stalemate in the metaphysical debate and the inconclusive results from neuroscience and empirical psychology, still partial and controversial, can be linked to the idea of "capacity".

By capacity, in the context of free will, one means the availability of a repertoire of general skills that can be manifested and used without the moment by moment conscious control that is required by the second condition of free will we have previously discussed. Such an idea meets a robust compatibilist line of argument[26] that states that ordinary or metaphysical free will is not necessary in order to hold someone accountable.[27]

Responsible persons are those with the adequate level of mental capabilities, namely those that are necessary in order to be moral agents. A person can be held accountable for their behaviour if their actions are the outcome of mechanisms that confer upon this person mental capacities such as the ability to perceive the world without illusions, to think clearly, to drive their own choices in light of their judgement, and to resist the impulse of acting instinctively. The central idea is therefore that of mental abilities.

The compatibilist view of responsibility (meaning the ability to answer for one's actions, and to assume the consequences at the cognitive level and subsequently at the moral one) is well illustrated by Fischer and Ravizza.[28] Based on their theory, we can say that this kind of responsibility (which is the premise for moral responsibility), whether or not determinism holds true, is based on control – not regulative control, which assumes the possibility of doing otherwise, but guidance control, which

> should be understood in terms of two elements: the agent's "ownership" of the mechanism that actually results in the relevant behaviour, and the "reasons-responsiveness" of that mechanism. So, for example, an agent is responsible for an action, on our account, to the extent that this action issues from the agent's own, reasons-responsiveness mechanism.[29]

According to these authors, the examples given by Harry Frankfurt convincingly show that, counter to the incompatibilist view, responsibility does not require an ability to do otherwise.[30] Consider the example that Fischer and Ravizza adapt from Frankfurt himself: John is in complete political disagreement with the mayor of his city, and believes that the latter's policies are profoundly harmful; therefore, he resolves to kill him.

John reveals his criminal plan to a friend, Robert, who shares his worries. Robert, who fears that John may not go through with his plan, contrives to implant in John's brain, completely unbeknownst to him, a sci-fi device that can be activated by remote control to induce the desired behaviour in its bearer. When John, armed with a pistol, approaches the mayor, Robert follows him closely, ready to activate the device. John, however, does not flinch from his task: as soon as he is within range, he pulls out the pistol and shoots the mayor dead.

Frankfurt's idea is that John is responsible for his act, even if he could not have done otherwise. Indeed, had John hesitated, Robert would have activated the device implanted in John's brain, and John would have killed the mayor anyway. Fischer and Ravizza's argument holds that in order to be responsible, some form of control is necessary – the type of control which, for example, a driver has who wants to turn right and succeeds in doing so by bringing the necessary skills to bear, even though a mechanical malfunction prevents the vehicle from turning left. Assuming one has guidance control, the second condition holds that one must be able to understand the reasons behind a certain behaviour and be able to apply them to one's own actions.

This does not contrast with causal determinisim, as classical compatibilism applied to freedom teaches us as exemplified by Hobbes and Hume: according to them, even if de-

terminism obtains, in order for an agent to be free it is sufficient for their actions to be causally determined by their will (or motives, impulses, desires). Agents are thus free to the extent that they carry out the actions they intend to carry out. The will of the agent is instead entirely determined by factors outside of the agent's control. Freedom can thus only be predicated of the actions of the agent, and not of the latter's will or the relevant mental events for those actions.

In the case of responsibility, in the absence of the possibility of doing otherwise, what distinguishes a scenario in which an agent is responsible is not the outcome (since, for example, John ends up killing the mayor anyway), but what the language of folk psychology would call "intention". When John shoots and kills because "he decided so" thanks to his "internal mechanism", he is in fact held intuitively accountable, while he is not if his friend Robert activates the remote-controlled device after John flinches. John has no control, he is manipulated like a puppet, and cannot in any way be held responsible for his deeds.

If, according to Fischer and Ravizza, cerebral lesions or mental illnesses can impair the guidance control, this does not happen when the agent is reasons-responsive. When an agent is (for example) hypnotized, he is not sensitive to reasons in the appropriate way. But if instead – assuming one is not under the influence of seriously pathological influences, manipulations, or situations – an agent ponders whether to turn part of her salary over to a charity organization, weighs the pros and cons, and reaches the decision to devote that sum, the agent can be considered responsible and be praised for an altruistic choice to help the poor.

The difference thus lies in the ability – which can manifest itself in various degrees – to respond to reasons with a measure of guidance control. A key ingredient in our account is regular reasons-receptivity. This sort of receptivity involves a coherent pattern of reasons-recognition. More specifically, it involves a pattern of actual and hypothetical recognition of reasons that is understandable by some appropriate external observer. And the pattern must be at least minimally grounded in reality.[31]

Morse is a typical exponent of compatibilism, which implicitly justifies modern legal practices with the arguments on responsibility presented by Fischer and Ravizza.[32] In this light, determinism does not cause problems in establishing the elements of penal responsibility, namely the existence of an action accompanied by a mental state appropriate for the circumstances, along with the presence of causation between the deed and the outcome, and a defence based on the subject's coercition or a mental illness can exist. According to Morse, certain behaviours can be considered actions, while others cannot (such as epileptic tremors, convulsions, nervous tics, sleepwalking). And actions, even under the determinist view, are carried out either with the required mental states (intention, purpose, awareness) or without them. For Morse, the fact that there are causes is not an excuse.

This approach based on capacity and cognitive control encompasses a synthetic idea of freedom and responsibility useful precisely for moral and legal contexts. It should be noted that in our opinion the compatibilist idea of free will and responsibility as proposed for example by Fischer and Ravizza, from a philosophical point of view, does not seem to be able to withstand the criticism made by hard determinists.[33] The approach of cognitive abilities, however, is useful when you want to put in brackets the currently unsolvable problem of free will considered in its classical form, so as to outline a kind of free will useful for moral and legal contexts, notwithstanding the limitations of this approach.

Operationalizing free will

The ultimate goal of our project is to overcome the interpretative and factual controversies with an operationalization and measurement of the capacities that identify the freedom-responsibility of the subject.

The so-called interpretative controversies would be overcome by finding a specific and operationalized definition of freedom, on the basis of reliable data that can be gradually made more precise through the refinement of the tools and the integration of theoretical knowledge.

In other words, the aim is to make someone's degree of freedom measurable, by resorting to the abovementioned notion of capacity. The so-called factual disputes concern instead the actual possession by the given individual of the abovementioned capacities and control that make her free and responsible. In other words, the aim is to establish in an increasingly precise way the extent to which a person is free in terms of capacity and self-control.

At present we lack guidelines for empirical research in criminal law assessments. The identification of indexes to measure free will is extremely important to establish the liability of the defendant. Also, relying on more objective measures of free will and responsibility may contribute to reducing potential uncertainty due to the subjectivity of psychiatric assessments. There could also be interesting reverberations in terms of public opinion, as the question "how free are we?" is a very important issue in the event of social conflicts and criminal cases. The consideration of human beings and human behavior might change to a greater or lesser extent on the basis of the degree of free will that we attribute to individual behavior, and as a consequence, to individual responsibility.

The use of our index would not imply that criminals will be just pardoned or quarantined (as suggested by hard determinists like Smilansky or Pereboom).[34] On the contrary, scientific evidence will allow justice to become fairer by enabling a finer discrimination of the cases in which punishments should be administered from those in which efforts should be made to help criminals recover the maximum extent of free will. This in turn will lead to rehabilitation programs that will promote the reintegration of offenders within society.

On the other hand, it should be immediately clear that we are speaking here of a specific concept of freedom which does not cover all cases of mental illness currently recognized by contemporary criminal codes. Ours is, as already stated, a tentative proposal in view of a project that must necessarily follow different stages of refinement and validation.

The cognitive abilities we mentioned could be operationalized as a set of neuropsychological tests. They would be used to measure specific executive functions, central to the idea of control we have previously seen. Executive functions, or control functions, allow one to organize and plan one's behavior.[35] These skills are required to perform intentional activities, aimed at achieving objectives, monitoring and performing multiple tasks simultaneously, and changing behavior based on feedback on the results obtained.

They are involved in tasks of abstraction, inventiveness, judgment and criticism. A potential deficit would be evident in daily living, manifesting itself as inappropriate social behavior, problems in decision making and in the ability for critical judgment, difficulty in conceiving, performing and changing action plans or adapting them to changes in the environment, excessive distractibility, and so forth.[36] In general terms, the executive functions refer to the set of mental processes necessary for the development of cognitive-behavioral patterns adaptive in response to new and demanding environmental conditions.[37]

The domain of executive functions includes:

- the ability to plan and evaluate effective strategies in relation to a specific purpose related to the skills of problem solving and cognitive flexibility;

- inhibitory control and decision-making processes that support the selection of functional response and the modification of the response (behavior) in relation to changing environmental contingencies;

- attentional control with reference to the ability to inhibit interfering stimuli and to activate relevant information;

- working memory with reference to the cognitive mechanisms that can maintain online and manipulate information necessary to perform complex cognitive tasks.

Measuring free will

In this light, a possible hypothesis is that of relevant tests – compatible with one another – and, adequately weighting each measure, a uniform index: a sort of IQ-like profile that would attest to the subject's relevant cognitive skills. This is consistent with the few proposals so far advanced in order to operationalize free will. For example, Vohs maintains that free will can be thought of as the sum of executive functions and goal-directed, future-oriented behaviors, which include rational choice, planning, intelligent thought, and self-control.[38] Free will can then be constituted by a limited stock of energy, devoted to guiding executive functioning processes. According to Vohs, the decision-making system is operates in this way thanks to scarce psychological resources.

And this is also consistent with Baumeister's well-known position about the contribution that psychology can offer:

> Psychologists should focus on what we do best: collecting evidence about measurable variance in behaviors and inner processes and identifying consistent patterns in them. With free will, it seems most productive for psychologists to start with the well-documented observation that some acts are freer than others. As already noted, dissonance, reactance, coping with stress, and other behaviors have been shown in the laboratory to depend on variations in freedom and choice. Hence, it is only necessary to assume that there are genuine phenomena behind those subjective and objective differences in freedom. In a nutshell, we should explain what happens differently between free and unfree actions. Thus, the optimal agenda for psychology would be to find out what people mean when they use concepts of freedom, choice, and responsibility in their daily lives and then to illuminate the inner processes that produce those phenomena.[39]

There are many difficulties in this project, starting with the use of common insights as a guide for psychological research. But there are also elements of strength, emerging from the most recent neuroscientific research. If in fact self-control can generally be brought within the broader concept of free will, recent studies indicate that self-control can actually be one of the main components of the concept of freedom revisited in the light of empirical research. Self-control is the exertion of willpower on behavior. Thus, self-control can be defined as the capacity to override individual impulses and automatic or habitual responses,[40] or as the ability of higher-order psychological functions to modulate the activity of lower functions.[41]

Controlling the self is important for achieving long-term goals that require either the suppression or the delay of immediate gratification, for interacting with others and for obeying social norms. Ability to exert self-control may vary greatly among individuals, as well as within the same individual across time, depending on personal (e.g., mood states) or environmental circumstances.[42]

As a matter of fact, criminological research has provided a growing body of indications that alterations in the self-control process may play a role in many criminal acts.[43] For the penal system of most countries, including Italy and the USA, the current state of the definition of individual legal responsibility takes into account only two possible conditions for the mitigation of criminal acts, namely a state of *mental insanity* or of *reduced capacity*, that are considered, respectively, to fully abolish or to greatly di-

minish the exertion of self-control. According to Baumeister,

> self-control gives the capacity to alter your behavior to conform to the group's rules, and rationality enables you to work out your own rules and then behave accordingly. This line of thought fits the view of free will as a sometime thing. People are incompletely rational and self-controlled. They have the capacity for acting rationally and exerting self-control, but they only use it sometimes. This suggests the capacity is limited.[44]

Indeed, two executive functions turn out to be central:

> (i) the ability to predict the future outcomes of a given action; and (ii) the ability to suppress inappropriate, i.e., not sufficiently valuable, actions. Importantly, these two executive functions operate not only during the genesis of an action, but also during the planning of an already selected action. In fact, during the temporal gap between the time when an action has been chosen and the moment when the motor output is going to be generated, the context might have changed, altering the computed value of the action and thus requiring a radical change of the planned motor strategy.[45]

It seems that the peculiarity of our freedom at the cognitive level is to modulate or block courses of action that automatically or unconsciously environmental stimuli arouse in us – a reproposal in different form of Libet's criticized free won't. Given these premises, certainly worthy of further investigation, the next step is to start building a possible scale, that might not have the ambition to measure free will as such, but that would account in a progressively more precise way, both conceptually and methodologically, for individual differences, certainly relevant in the scenarios of moral decision and court cases.

Below we present our choice between common tests widely believed to be reliable in their area of evaluation. For each there is a brief explanation of the features, the route of administration and cognitive function being tested.

TESTS	COGNITIVE FUNCTIONS	
Raven's Coloured Progressive Matrices	Clear-thinking ability and logical deductive reasoning	ES
Trail Making Test	Multitasking attention, conceptual set-shifting abilities, mental flexibility	ES
Stroop Test	Automatic response inhibition	ES
Wisconsin Card Sorting Test	Ability of "set-shifting"	ES
Weigl's Color-Form Sorting Test	Ability of problem-solving	ES
Semplified London Tower Test	Planning, working memory and nonverbal problem-solving	
Digit Span Backward	Working memory	ES
Verbal Judgment Task	Acquired-knowledge verbal logical reasoning	ES

Supplementary Tests	COGNITIVE FUNCTIONS
Cognitive Estimation Test	Deductive reasoning
Iowa Gambling Task	Decision making under ambiguity
Go / No-Go Test	Sustained attention and response control/inhibition

Raven's Coloured Progressive Matrices

Raven's Coloured Progressive Matrices (CPM47) measure clear-thinking ability and logical-deductive reasoning. The test consists of 36 coloured matrices in 3 sets (A, Ab, B), with 12 items per set. Each matrix consists of a higher part with a stimulus figure lacking a small piece and a lower part containing six possible answers. The subject has to select one. The Raven's CPM produces a single raw score that should be corrected to obtain an Equivalent Scores (ES). [46]

Trail Making Test

The *Trail Making Test* consists of two parts (part A and part B). Part A can provide information about speed of processing, while part B can provide information about mental flexibility, as well as executive functioning. The task of part A requires a subject to "connect-the-dots" of 25 consecutive targets on a sheet of paper or computer screen. In part B the subject alternates between numbers and letters (1, A, 2, B, etc.). If the subject makes an error, the test administrator is to correct them before the subject moves on to the next dot. The goal of the test is for the subject is to finish as quickly as possible; the time taken to complete the test is used as the primary performance metric that should be corrected to obtain an ES. Error rate is not recorded in the paper and pencil version of the test, however, it is assumed that if errors are made it will be reflected in the completion time.[47]

Stroop Test

The Stroop effect is a demonstration of interference in the reaction time of a task. When the name of a color (e.g., "blue", "green", or "red") is printed in a color not denoted by the name (e.g., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color. There are different test variants commonly used in clinical settings, with differences between them in the number of subtasks, type and number of stimuli, times for the task, or scoring procedures. A variant has three subtasks. In the first trial, names of colors printed in black ink have to be read (30 items). In the second trial, there are dots printed in a given color and the participant has to name the color of the ink (30 items). In the third trial, the written color name differs from the color ink it is printed in, and the participant must name the ink color (30 items). The Stroop Test produces two raw scores (time and errors) that should be corrected to obtain an ES. This test is considered to measure selective attention, cognitive flexibility and processing speed.[48]

Wisconsin Card Sorting Test

The *Wisconsin Card Sorting Test* (WCST) is a test of "set-shifting", i.e. the ability to display flexibility in the face of changing schedules of reinforcement. The WCST can provide information about strategic planning, organized searching, utilizing environmental feedback to shift cognitive sets, directing behavior toward achieving a goal, and modulating impulsive responding. A number of stimulus cards are presented to the participant, who is told to match the cards, but not how to match; however, he or she is told whether a particular match is right or wrong. The test generates a number of psychometric scores, including numbers, percentages, and percentiles of: categories achieved, trials, errors, and perseverative errors.[49]

Weigl's Color-Form Sorting Test

The Weigl's Test can provide information about abstract processes, problem solving and the ability to perform different categorizations. There are 12 different colored figures.

The task requires the subject to sort the 12 colored figures of various shapes into groups and then to re-sort them according to a differ-

ent criterion. The Weigl's Test produces a raw score that should be corrected to obtain an ES.[50]

Semplified London Tower Test

The *Semplified London Tower Test* (SLTT) is used to detect deficits in planning, working memory and nonverbal problem-solving. The test consists of a board with three pegs with different heights and three beads with different colors. The subject has to move the beads from an initial configuration to a final one following three rules: move a bead at a time, move the beads only by one peg to another, the shortest peg can hold only one bead, the middle two beads, the highest three. There are six problems of increasing difficulty each presented three times. The SLTT produces two raw scores (number of moves and time of completion) that should be corrected to obtain ES.[51]

Digit Span Backward

Digit Span Backward can provide information about the ability to retain information for a brief time and then use it for a task. DSB is the longest list of numbers that a person can repeat back in correct order immediately after presentation on 50% of all trials. A list of random numbers is read out loud at the rate of one per second. The test begins with two to three numbers, increasing until the person commits errors. At the end of a sequence, the person being tested is asked to recall the items in reverse order. The DSB produces a raw score that should be corrected to obtain ES.[52]

Verbal Judgment Task

The test is used to assess verbal-logical reasoning skills based on acquired knowledge. It includes 4 subtests, each of which consists of 5 items: differences between a pair of words, explaining the metaphorical meaning of a proverb, finding an absurdity contained in a sentence, classifying a series of words in one term. The *Verbal Judgment Task* produces a raw score that should be corrected to obtain an ES.[53]

Cognitive Estimation Test

The *Cognitive Estimation Test* (CET), which purportedly assesses aspects of executive functioning, consists of answering questions that require deductive reasoning. This test assesses the ability of reasoning based on research strategies and critical comparison of information of the foreground repertoire. There are 21 questions that do not provide a single and precise answer, but that require a numerical estimate. The estimates relate to different units of measurement (weight, length, frequency, capacity, durability, speed, etc.). There are two scores: errors and oddities, that is, answers that deviate significantly from those that are acceptable.[54]

Iowa Gambling Task

The *Iowa Gambling Task* is a psychological task thought to simulate real-life decision making. Participants are presented with 4 virtual decks of cards on a computer screen. They are told that each time they choose a card they will win some game money. Every so often, however, choosing a card causes them to lose some money.

The goal of the game is to win as much money as possible. The decks differ from each other in the number of trials over which the losses are distributed. Thus, some decks are "bad decks", and other decks are "good decks", because some will lead to losses over the long run, and others will lead to gains. Most healthy participants sample cards from each deck, and after about 40 or 50 selections are fairly good at sticking to the good decks. Patients with orbitofrontal cortex (OFC) dysfunction, however, continue to perseverate with the bad decks, sometimes even though they know that they are losing money overall.[55]

Go / No-Go Test

This test was developed to assess response inhibition in a rapid computerized assessment format. Subjects learn to discriminate between two response alternatives (right or left mouse button, or screen presses directly on the stimuli). Subjects are asked to respond and pick the correct choice, based on which stimulus is colored green, the "go" stimulus, while the other stimulus is blank. On some trials, however, one of the stimuli is colored red, which is a signal to not respond at all ("no-go" trial). The frequency of "go" stimuli relative to "no-go" stimuli is 80%, which maintains a bias and tendency to respond on every trial. Key dependent measures include both reaction times for all "go" responses, and error frequencies, the most important of which are "false alarm" errors (i.e., a response to a "no-go" stimulus). The test adapts to the subject's rate of performance, maintaining a maximum pace of administration.[56]

Decisional Quotient (DQ), free will as capacities and self-control

All the tests should be corrected for age and education and then transformed into new standardized scores (Equivalent Scores, ES) on an ordinal scale, e.g. (according, for example, to Italian norms) ranging from 0 to 4, with 0 representing scores below cut-off point and 1 including borderline tolerance limit.[57] Specific standardized scores exist in many countries or linguistic areas. The subjects would get for each test a raw score (or RS), given by the sum of the scores obtained in each item that makes up the test, which would then be standardized. In short:

0 = scores below cut-off point
1 = borderline tolerance limit
2 = sufficient
3 = more than sufficient
4 = equal to or better than average.

The tests would be used in a partially new way, so there should be a slightly different interpretation of the quantitative data. Since the idea of granting freedom to people is intuitively clear enough, the first description of the numerical values may be as follows. It is understood that this is a sketched proposal, which is expected to be significantly refined with practice.

Prevalence of ES = 0: the subject manifests an inability in dealing with decision-making tasks.

Prevalence of ES = 1: the subject exhibits a very low capacity in dealing with decision-making tasks.

Prevalence of ES = 2: the subject shows a capacity in dealing with decision-making tasks that presents strong limitations in many areas compared to what is believed to be the standard.

Prevalence of ES = 3: the subject shows a capacity in dealing with decision-making tasks that has some limitations in specific areas compared to what is believed to be the standard.

Prevalence of ES = 4: the subject shows a capacity equal to or better than the average in dealing with decision-making tasks.

If there is not the prevalence of a particular ES or the subject manifests a varied profile, in the presence of scores from 0 to 1 the subject will have to be regarded as having a severely limited capacity at least in some areas, which tends to affect the entire capability profile. Moreover, the ES-free tests suggested as possible complementary tests would help to refine the discrimination between equivalent values in interpersonal comparisons and could then be integrated in the general index.

DQ as a first step

As we have tried to explain, a synthetic

index such as the one we propose measures a certain range of cognitive and behavioral control skills that configure a certain kind of free will at the psychological-functional level. These are potential capacities measured with standardized instruments and laboratory situations, which do not consider any other factors that may restrict the freedom of a subject in specific situations, such as those that are relevant in moral scenarios and legal contexts. The law, as is known, is expected to consider the state of the subject at the precise moment when she committed the crime and not her general state. The same goes for moral judgment.

However, an index such as the one we are proposing could be the first step, certainly imperfect, towards more objective measures to discriminate between "sane" and "mentally ill" people, to the extent that they are more or less "free" accordingly, that is, capable of self-control and rational choice. The fact that these are psychological-functional indicators does not imply that the cerebral bases of these functions are not involved as well. For instance, consider the motivation to act, caused by an evaluation process aimed at determining whether or not the individual's current needs are satisfied.

This is an essential process and one that is continuously performed by our motor system. In fact, in most places where we live, if not all, we are surrounded by tools whose sight automatically activates motor schemas that would normally be employed to interact with those objects. These actions are prompted by the features of the objects, the so-called *affordances*. It has been shown that even the simple observation of pictures depicting affordable objects (such as graspable objects) activates a sub-region of the medial frontal cortex, the supplementary motor area (SMA), even when there is no requirement to actually act on those stimuli. These stimulus-driven activations are rapid, involuntary, and unconscious.[58]

It seems that we are induced to act by a process of priming caused by environmental cues that stimulate our predispositions to action, which on average people can "resist". Yet, for example, those who have micro-lesions of the SMA tend to always perform such actions without the ability to choose based on overall circumstances.[59] In fact,

> the suppression of a triggered action might be seen not as an active process, but rather as an automatic consequence of the evaluative procedure.[60]

You could say that those who are "freer" have the ability to control and direct behavior. Those suffering from disorders in that evaluative procedure are not able to match the stimulus-induction with the action with a congruent internal state, which in "sane" people (or those who are "freer") allows them for example to block the utilization behavior, but also to stop harmful behaviors (by implementing a behavior characterized by greater self-control, that is a feature of free will). Then why not go straight to the most basic level of explanation?

Prima facie, this seems justified both from the epistemological point of view, and from the legal point of view. In this context, in fact, a person who wants to manipulate test results to their advantage may be able to give insincere answers thus bypassing the control procedures designed to avoid casual or systematically distorted responses. So, instrumental tests on the brain would avoid any risk of "deception". However, it seems to us that going straight to the most basic level of explanation available is not the best route.

First because, obviously, we do not have a reliable mapping to match the behavioral performance to the differential activation of brain areas that are believed to control the former. Second, we do not believe that this is even possible in principle, and we think, therefore, that the functional level can give us a better understanding than the "cerebral" one: reliable knowledge useful both for the evaluation of the "degree of freedom" of a subject and for the comparison between individuals.

In this perspective, one may think of a framework that is neither reductive nor eliminative.[61] Rather, one may adopt the framework of *explanatory pluralism*, which recently has become a relevant topic in philosophy of science. Its gist is that

> theories at different levels of description, like psychology and neuroscience, can coevolve, and mutually influence each other, without the higher-level theory being replaced by, or reduced to, the lower-level one.[62]

The focus is on the growth of explanatory resources; this allows the pluralist to carve a third way in between the excessive reductionist insistence on ontological parsimony and unification of science, on the one hand, and the antireductionist claim for the strong autonomy of special sciences, on the other hand.[63] Craver's model of mechanistic explanation is a good exemplar of explanatory pluralism.[64]

According to Craver, this view of mechanistic explanation can provide us with an account of inter-field integration that is preferable to the reductionist one. Against the reductionist claim that when lower-level explanations are completed, the higher-level explanations stop being causally explanatory, the explanatory pluralist denies the existence of a fundamental explanatory level, and argues that higher-level entities continue to play a causal and explanatory role even when lower-level explanations are complete.

In this perspective, then, the most serious shortcoming of the reductionist conception of the relation between lower and higher levels is its unidirectional nature: since it assigns a priority to lower levels, when the higher-level and lower-level theories fail to map onto one another neatly, the blame lies exclusively on the upper-level one.[65] By contrast, the pluralistic perspective is bidirectional: the higher-level theory should be subjected to revision in light of the findings of the lower-level theory, and vice versa.

This approach has two implications. On the one hand, the functional knowledge obtained through psychological research allows us to identify the neural mechanisms; on the other hand, the knowledge of structure is a heuristic guide to the development of more sophisticated psychological models.[66] So, the index of freedom that we propose could be a tool to investigate the brain mechanisms that underlie what appears in behavior as "free will".

Conclusion

The index that we propose, springing from a set of neuropsychological tests used to assess neurocognitive deficits, is characterized by better assessing the space that could be called "from normality to pathology, and the various degrees of pathology". To enrich the index, in the future one may think about integrating two other elements with appropriate tests.

One concerns mental openness, operationalized and measured by tests of creativity (which we know are still not very accurate or reliable) and the other concerns the repertoire of personal experiences (difficult to operationalize) that influences the degree of freedom as a functional capacity of the monitoring system, powered by known alternatives in memory. This in fact recalls the general idea of alternative possibilities that lies at the heart of the ordinary idea of freedom. Those with little knowledge of an area of the world and little ability to see new solutions will also have less "freedom".

As repeatedly stated, this is only the beginning of a journey that will certainly need the contribution of different philosophical, psychological and neuroscientific skills as well as numerous empirical validations. But we do think it may be a promising and useful path to pursue for the applications we have described, without claiming to exhaust the full spectrum of free will, which is probably destined to remain a forever elusive concept.

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