Perspectives on the Experience of Will

Davide Rigoni *
davide.rigoni@unipd.it

Luca Sammicheli **
luca.sammicheli@unibo.it

Marcel Brass ***
marcel.brass@ugent.be

ABSTRACT

In the last decades, psychologists and neuroscientists brought the concept of human will out of the philosophical debate. Here we critically examine the different attempts within the field of cognitive neuroscience to study neural processes underpinning human will. Volition has been investigated under different perspectives: while some threads of research focused on the subjective experience of free will (i.e., will under a self perspective), others explored how the brain is able to identify free will in other individuals (i.e., will under a other perspective). In addition, we comment that perceiving free will in others is tightly connected to the ethical and juridical concept of personal responsibility. Finally, we present a promising theoretical framework that stresses the pragmatic value of believing in free will. Rather than focusing on the subjective experience of volition itself, this approach studies whether believing in free will or not has an impact on brain processes underlying willed behaviour.

1. Introduction

The subjective feeling of controlling our own actions is an intuitive and pervasive component of human experience. When switching on the TV to

* Department of Developmental Psychology and Socialization – University of Padua
** Faculty of Psychology – University of Bologna
*** Department of Experimental Psychology – University of Ghent

watch the news or when entering a pub to order a cappuccino, we have the clear feeling of voluntarily and freely determining our choice. The question of how we can voluntarily control our behavior has always fascinated researchers from different disciplines such as philosophy and psychology. This question is fundamental to what it means to be a human being and is tightly related to socially relevant issues, such as personal responsibility and self-control.

The fascination for willed behavior is to some degree fuelled by the *vexata quaestio* of free will. In the last decades, cognitive neuroscientists and experimental psychologists focused on intentional actions, sometimes assuming – more or less explicitly – that understanding brain processes involved in conscious and voluntary actions (i.e., those actions that we perceived as *free*) would provide an answer to the question whether free will exists or not, or at least would modify our notion of volition. However, it is highly questionable whether the fields of neuroscience and experimental psychology have tools for answering the question whether free will, in philosophical terms, exists.[1] As Roskies concluded in her recent review, «neuroscience has not much affected our conception of volition [...]» but «[...] it has typically challenged traditional views of the relationship between consciousness and action» (Roskies 2010, p. 123).

Therefore, the present paper will focus on the neural mechanisms underlying the *subjective experience of free will or volition* without trying to relate these findings to the philosophical problem of free will.

In the first part, we will critically discuss a series of empirical findings within the field of cognitive neuroscience that explored what brain mechanisms precede the experience of free will. These findings have strongly influenced the notion of the relationship between consciousness and intentional actions. In the second part, we will examine the *reconstructive* approach of the experience of will. According to this perspective, our experience of volition is strongly influenced by events occurring after the action is executed and sometimes is retrospectively reconstructed. Then we will briefly discuss how we perceive free will in others. This part of the paper will outline the processes that underpin our ability to identify intentionality in other individuals. In addition, we will describe how tightly these processes are related to ethical and juridical issues. Finally, we conclude by presenting a recent theoretical framework that stresses the pragmatic value of believing in free will. Rather than focusing on

[1] For a recent review, see Roskies 2010.

the subjective experience of volition itself, this approach studies whether it has any implication whether we believe in free will or not.

2. The Subjective Experience of Volition: Cause or Consequence

From a phenomenological point of view, we may define as *free* those actions that are performed intentionally and with a minimum of external constrictions. When we have the intention to perform a specific action, we feel that our intention is, somehow, *causing* the action itself; in other words we feel that our action is *determined* by our intention to perform that action. We refer to this feeling of willing as *conscious intention* (Haggard 2005).

A first line of research within the field of cognitive neuroscience has focused on whether the subjective experience of free will plays a causal role in the initiation of behaviour. In a pioneering experiment, Benjamin Libet and colleagues (Libet *et al.* 1983) applied neurophysiological methods to study the relationship between the electrophysiological brain activity associated with voluntary movements and conscious intentions. The main interest was on the *temporal relationship* between motor-related brain potentials, as recorded with the electroencephalogram (EEG), and the 'conscious feeling of intending to act'. Thus, the question was: *when* do people become aware of their own decision to do a certain movement? And what happens in the brain in the meantime?

An implicit problem in investigating internal representations such as the conscious intention to perform a movement, is that it is impossible – at present, at least – to obtain a direct and objective measure of *when* a person becomes aware of his or her conscious intention. It is not possible to have a direct access to the 'internal world' of others and therefore, to obtain an estimation of when people had the conscious intention to execute a movement, experimenters must rely on introspection (i.e., subjective reports of inner states). Libet and colleagues (Libet *et al.* 1983) developed a method that allowed to compare subjective self-reports with brain activity. In the experiment, participants were seated in front of a screen displaying a clock with a rapidly moving spot and they were asked to execute a rapid movement (i.e., a wrist flexion), at will. Afterwards, they were asked to report what time it was (i.e., the position of the spot in the clock) when they had the first subjective experience of intending to act (see *Figure 1*). Libet referred to this reported

time as the will judgment (W). At the same time, movement-related cortical potentials were recorded by means of a surface electrode placed on participants' scalp.

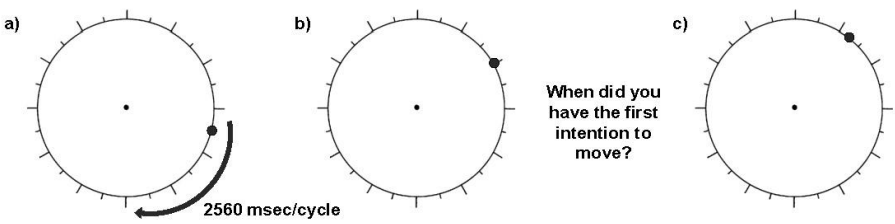

Figure 1: A typical Libet's clock paradigm is represented. (a) Participants make a voluntary and spontaneous finger movement while watching a cursor moving clockwise around a clock face. (b) At a variable time after finger movement, the cursor stops. (c) Then, participants are asked to report the position it was when they had the first intention to make the movement.

Libet was mainly interested in a well known cortical potential, the *Bereitschaftspotential* or *readiness potential* (RP) (Kornhuber and Deecke 1965). The RP is a slowly increasing negative potential which starts up to 2 seconds before voluntary and spontaneous movements and is bilaterally symmetrical over the pre- and post-central region, with a maximum at the vertex (Shibasaki *et al.* 1980, Shibasaki and Hallett 2006). The RP is generated by the supplementary motor area (SMA) – including pre-SMA and SMA proper –, a brain region involved in the late stages of motor preparation (Shibasaki and Hallett 2006). It is associated with spontaneous and voluntary movements and it is absent or greatly reduced before involuntary movements or movements made in an automatic manner (Shibasaki and Hallett 2006).

In the original experiment (Libet *et al.*, 1983), participants' voluntary movements were preceded by a RP beginning 500 ms to about 1000 ms before movement onset. The W-judgment, indicating the time when people had their first intention to move, was approximately 200 ms before the motor response. Therefore, the brain potentials reflecting motor preparation began about 300 to 800 ms *before* the person consciously intended to act. Conscious intentions would thus seem, the authors concluded, to be a latecomer in the process of

decision, rather than the generator of the action.

Several theoretical and methodological aspects of the Libet's clock paradigm have been extensively questioned (Hallett 2007, Pockett and Miller 2007, Roskies 2010). However, despite the numerous theoretical and methodological critiques[2], the Libet's clock has been widely used to investigate conscious intentions and it still offers «one of the few viable methods for experimental studies of awareness of action» (Haggard 2005, p. 291). Furthermore, the main result of Libet's experiment has been repeatedly confirmed by other empirical studies that clarified the temporal relationship between conscious intentions and brain processes underlying motor preparation. For instance, Haggard and Eimer (1999), replicated the original findings and found that the reported W correlates only with the late part of the RP – i.e., the lateralized RP – that represents the stage at which the representation of an abstract action is translated into representation of a specific movement (i.e., "Do that!"). This finding suggests that we become aware of our own intention to perform a voluntary movement only when information about which specific movement has to be made is represented in pre-motor areas (Haggard and Eimer 1999).

These data show that our motor actions are preceded by preconscious brain activity, which enters our awareness only at a later stage, just before the action is executed. Therefore, a plausible conclusion is that conscious intentions are not the first source of our behavior as voluntary actions would be primarily determined by brain activity that enters consciousness only at the later stages (Hallett 2007).

However, these conclusions are far from being uncontroversial. For instance, Trevena and Miller recently questioned the assumption that the RP is specifically associated with voluntary movements (Trevena and Miller 2010). They thought to show that the RP is not necessarily followed by an overt movement and therefore it cannot be considered a *specific* marker of voluntary movement preparation. However, their experimental setup has also been criticized (Gomes 2010). Therefore, further research is needed to better clarify the relationship between brain processes underlying voluntary movements preparation and the subjective experience of intention.

It is noteworthy to mention that more recent studies extended the hypothesis that our behavior is determined by unconscious brain activity using

[2] See Haggard 2008; Hallett 2007; Pockett and Miller 2007.

functional MRI. For instance, Soon and colleagues (Soon *et al.* 2008) used a modified version of the Libet's clock in which participants had to freely decide between a left and a right button press that they should execute at a freely chosen time. Then, participants reported the time at which the conscious motor decision was actually made. They found that the outcome of the decision – i.e., whether the left or the right button – was encoded in the brain activity of prefrontal and parietal cortex up to 10 seconds before it entered awareness. The decoding accuracy was about 60%. Thus, these data show that brain activity preceding awareness can predict our conscious decisions[3]. It is crucial to note here, however, that the prediction even though reliable was far from being perfect. With an accuracy of 60%, that is, 10% above chance, it is difficult to argue that these information *determine* our decision. This finding does not tell us that our conscious decisions are fully determined by such unconscious processes; rather it indicates that our conscious decisions are *biased* by brain activity reflecting unconscious processes. One crucial question is whether the low accuracy is due to methodological shortcomings or to principle reasons, namely that the bias is simply not stronger than, for example 10 %. It would be interesting to further investigate whether it is possible to influence the accuracy of the prediction.

3. Reconstruction of Intentions and Apparent Mental Causation

In voluntary actions we experience that the conscious intention to perform an action precedes the action itself. Subjectively, the intention to press a key *determines* or *causes* the key press. A series of empirical studies in experimental psychology and neuroscience attempted to challenge this intuitive experience by focusing on cognitive and brain mechanisms underlying the evaluation of the consequences of our actions, as these processes seem to influence the subjective experience of conscious intentions.[4] Empirical data suggest that the subjective experience of the conscious intention is strongly influenced by events occurring *after* the action

[3] Indeed, what is *unconscious* is not the brain activity itself, but the mental state associated with that brain activity.

[4] See Banks and Isham 2009; Kühn and Brass 2009; Lau *et al.* 2007; Rigoni *et al.* 2010; Wegner and Wheatley 1999.

is executed. Conscious intentions would then be, at least partially, retrospectively *inferred* from events occurring after an action is executed.

A study by Lau and colleagues (Lau *et al.* 2007) provided evidence in favour of this *reconstruction hypothesis*. They applied a Transcranial Magnetic Stimulation (TMS) over the pre-supplementary motor area (pre-SMA) after the execution of a simple spontaneous movement while participants were performing a Libet's task. They found that when the TMS pulse was applied 200 ms after movement execution, the perceived onset of the conscious intention shifted backward in time, indicating that the experience of conscious intentions involves activity of the pre-SMA taking place after the execution of action.

Banks and Isham (2009) used a modified version of the Libet's procedure in which participants were asked to press a button at will and to report the W judgment – i.e., the time they had the intention to press the button. Immediately after each button press, an auditory feedback was delivered at variable delays of 5, 20, 40, or 60 ms, in order to signal a response later than the actual one. Although participants were not aware of the delay, their W judgment moved forward in time linearly with the delay of the auditory feedback, indicating that people estimate the timing of their conscious intentions on the basis of the apparent time of response, rather than the actual response. In other words, people estimate the timing of their conscious intentions on the basis of the consequences of the actions, rather than the intention itself.

Rigoni and colleagues (Rigoni *et al.* 2010) extended these findings by applying electrophysiological recordings to the procedure used by Banks and Isham (2009) in order to investigate the psychophysiological mechanisms involved in the inferential processes of the conscious intentions. The authors demonstrated that the inferential processes by which the intention is reconstructed involve brain processes related to action-monitoring.

Taken together, these empirical findings show that the effects of intentional actions have an impact on the subjective experience of free will – at least on the subjective estimation of *when* participants had the intention to act. In addition, they challenge the intuitive view that voluntary actions are caused by the conscious intention to perform that specific action.

Other studies moved a step further and provided evidence that people may retrospectively reconstruct the experience of volition for actions that are executed unintentionally. For instance, Kühn and Brass (2009) combined a

stop-signal paradigm and an intentional action paradigm: participants were asked to press a button as fast as possible when a stimulus, say a letter, was displayed on a computer screen (*primary response* trials). Sometimes, right after the stimulus, either a stop-signal or a decision-signal was presented: with the stop-signal, participants had to inhibit the pending response, with the decision-signal they could decide whether responding to the stimulus or aborting the pending response (*decide* trials). In the decision trials in which participants provided a response, participants were also asked whether it was a voluntary response or a failed inhibition – i.e., participants were not able to stop the response. The aim of the study was to compare the reaction times (RTs) in the *decide* trials in which the subjects decided voluntarily to press the button with RTs in *primary response* trials in order to explore whether subjects were able to discriminate between acting without being able to stop (i.e., failed inhibition) and deciding voluntarily to resume the prepared action. If participants were able of distinguishing those states, there should be no *decide* trials in which subjects stated to have chosen voluntarily to resume the prepared action in the range of *primary response* RTs. That was because the process of stopping an ongoing action and reinitiating it voluntarily should take time. On the basis of this RT analysis, the authors showed that participants judged as voluntary responses that were in the time range of primary response RTs and were thus given unintentionally (i.e., failed inhibitions). Therefore, in some cases, participants had the experience of a conscious decision for unintentional responses.

A more radical view, proposes the so-called theory of *apparent mental causation* (Wegner and Wheatley 1999). According to this hypothesis, people feel that their conscious intentions are the source of their actions because they think about that action in advance of its occurrence, and because alternative sources of the action are not available. The human mind would assume a causal path from the intention to act to the action itself in order to explain the correlation between them (Haggard 2008). This correlation occurs because both the subjective experience of intention and the action are generated by a common process, that is the neural preparation of the movement. Several studies support the idea that sometimes conscious will is fabricated from the *perception* of a causal link between the thought and the action. For instance, Wegner and Weathley (1999) demonstrated empirically that people have the subjective experience that they performed intentional actions that were actually performed by another person. As Wegner commented, «conscious will is not

inherent in action» (Wegner and Weathley 1999, p. 11): conscious intention is not an intrinsic part of the process by which somebody acts, but it is an extrinsic accompaniments to that process.

Taken together, all these studies provide evidence that the experience of volition is biased by factors concerning the consequences of our behaviour. According to some authors, volition is a perception, rather than the generator of behavior. According to this model of free will, our brain motor's system would produce a movement as a product of its different inputs and would inform consciousness of the movement, that would be perceived as being freely chosen (Hallett 2007).

However, one has to be careful with drawing to far reaching conclusions from studies showing that our experience of will is sometimes illusionary. Arguing that free will is *always* an illusion on the basis of experimental observations that it is possible to generate an illusionary *will*, is, in our opinion, an overstatement. Indeed, it is like claiming that our visual system is delusional on the basis of demonstrations of visual illusions such as the Kanizsa triangle or the Müller-Lyer illusion.

4. Experiencing Free Will in Others

Imagine yourself sitting in a crowded bus. Suddenly the bus driver hits the brakes and the bus comes to an immediate stop. The person standing in front of you looses balance and falls on top of you. You feel pain and you are quite annoyed. However, despite a first impulse to react, you feel that a much more appropriate response is to say: "Don't worry, it happens!".

As indicated by the example above, we do not only feel that we are free; we also have a clear feeling that other people are free to act. In other words, as we have an *immediate* subjective experience of free will, we also have an *immediate* subjective experience of others' free will (Gallagher and Zahavi 2008). This ability to immediately and effortlessly discriminate between actions performed intentionally and actions performed unintentionally has been referred to as *intentional stance* (Dennett 1987).

The subjective experience of other people's free will is so instinctive and pervasive that virtually all human societies have formalized it into the juridical category of *personal responsibility*. Personal responsibility is an almost universal concept that is grounded on the ability to identify others' intentions:

the question of 'guilty' vs. 'innocent' actions is meaningful only if we consider the possibility to distinguish between *free* or *intentional* actions and *unintentional* actions.

Among the few studies that focused on the psychological mechanisms supporting juridical categories – in a perspective that in philosophy of law may be called *jus naturalism* – Hamilton tried to describe the *parallelism* between the juridical categories of personal responsibility and the Heider's levels of causal attribution (Heider 1958). According to Hamilton (1978), legal responsibility rules are approximately analogs to the Heider's responsibility attribution levels. For instance, the *association* attribution, in which a person is «held responsible for each effect that is in any way connected with him or that seems in any way to belong to him» (Heider 1958, p. 113), is equivalent to the Vicarious responsibility rule (e.g., regulations that tavern owners are responsible if liquor is served to minors, with or without the owner's knowledge or consent). Similarly, *intention* attribution – i.e., «only what a person intended is perceived as having its source in him» (Heider 1958, p. 113) – is typical criminal responsibility for an intended act (Hamilton 1978).

In law, the use of the different categories of personal responsibility requires the decoding of social behaviour (e.g., a crime) through *mind* constructs (e.g., the intention). That is, the implicit principle of personal responsibility is made explicit by the law in order to distinguish between a *signifier* (e.g., a punch) from a *non-signifier* action (e.g., an automatic reflex in the Tourette's syndrome).

What are the mechanisms by which our brain can distinguish *free* from *determined* actions? Whereas Libet focused on the problem of free will under a *self* perspective (i.e., the experience that '*I* have free will), here the problem is framed under an *others* perspective (i.e., the experience that '*others*' have free will). As outlined in the previous paragraph, attribution of intentionality is crucial for social interactions and for the regulation of human societies, as demonstrated by the existence of the categories of personal responsibility in the law. The study of social cognition – i.e., the processing of information related to the other human beings – is the mean by which the problem of free will – in the *others* perspective – can be investigated. The question moves from the description of the factors influencing the experience of free will to the investigation of cognitive and the neural processes underlying the attribution of free will to others.

Within the field of cognitive neuroscience, different hypotheses have emerged to describe brain mechanisms underlying our ability to attribute free will to others. However, all the different hypotheses rest on the assumption that the first step in the attribution of intention is the ability to distinguish biological from non-biological agents. That is, people must first classify interactions between objects as mechanical or intentional and discern the resence of *agents*, starting from perceptual information (Frith 1999). The brain network underlying the processing of biological motion involves the superior temporal sulcus and the premotor cortex (Beauchamp *et al.* 2002, Grossman and Blake 2002).

The ability to detect agency from biological motion (i.e., psychological causation or intentional movement) is considered a precursor of intentionality attribution. When we observe a biological motion, we attribute mental states to the observed movement, such as goals, intentions, desires. However, we would not attribute intentions to all biological agents but limit it, with a few exceptions, to human agents. Thus, perceiving free will in others requires the ability to understand also other people's goals and intentions. There are two competing hypotheses explaining how we are able to attribute intentionality to others (Gallese and Goldman 1998). The *simulation theory* suggests that people use their own mental mechanisms to predict the mental processes of others. According to the simulation theory, people simulate others' cognitive processes by deploying the same cognitive mechanisms. Conversely, the *theory* suggests that people understand others' intentions by acquiring a commonsense theory of mind, something similar to a *scientific* theory. In other words, people use inferential and deductive processes that do not involve simulation. The two processes involve distinct brain circuits: *simulating* involve premotor and parietal areas, the insula, and the secondary somatosensory cortex, while *theorizing* involve midline structures and the temporal-parietal junction (Keysers and Gazzola 2007).

It has been proposed that the two views describe different types of social interactions that are at the two extremes of a intuitive/reflective continuum (Keysers and Gazzola 2007, Uddin *et al.* 2007): simulationists focus on more intuitive examples in which intentionality is easily and effortlessly identifiable (e.g., when we observe a hand grasping a mug); investigators of the *theory theory* would be concerned with more reflective examples of intention attribution, in which the attribution of intention follows a conscious browsing

through what we know about the observed person and the context (e.g., when someone steps on our toes in a crowded bus) (Brass *et al.* 2007).

The discovery of the *mirror neurons* (Rizzolatti *et al.* 1996) provided an important insight into the brain mechanisms that might be involved in the attribution of others' intentionality. Mirror neurons are a special class of neurons in premotor areas that fire when we perform object-directed actions such as grasping, tearing, manipulating, holding, but also when we observe somebody else performing the same class of actions. Recent empirical findings indicate that the mirror neuron system may be involved also in goal and intention understanding (Hamilton and Grafton 2006, Iacoboni *et al.* 2005), but the involvement of the mirror system might be limited to intuitive situations, as outlined above.

An interesting approach is to link the mirror neuron system with the concept of *semantic nature of human behaviour* (Hauser 2006 and Rawls 1971), in which the *freeness* of a certain action *is* a semantic attribution that leads to an immediate and unavoidable perception of intentionality – "You are free!". Gallagher and Zahavi (2008) propose a theory of social cognition that emphasize the *immediacy* of the attribution of intentionality. This perspective is distinct from the two other main theories of social cognition – the *simulation theory* and the *theory theory*. According to the authors,

> Mirror activation, on this interpretation, is not the initiation of simulation; it's part of a direct intersubjective perception of what the other is doing. At the phenomenological level, when I see the other's action or gesture, I see (I directly perceive) the meaning in the action or gesture. (Gallagher and Zahavi 2008, p. 179)

This approach seems to be well supported from empirical findings on the mirror neurons in social contexts.[5]

Further research within neuroscience is needed to clarify how our brain *perceive* free will in others. For instance, Liepelt and colleagues (Liepelt *et al.* 2008) found that reasoning about the action and the context in which the action is performed have a strong impact on the brain processes underlying the attribution of intentionality to others. This suggests that the attribution of free will to others might be a prerequisite for the activity of the mirror-neuron system, rather than its consequence (Liepelt *et al.* 2008).

[5] See Gallagher and Zahavi 2008 for a review.

However, the attribution of mental states – such as intentionality – to others include other mechanisms as well, namely mechanisms that allow to distinguish one's own intentions from others' intentions.[6] This mechanism involves the right inferior parietal cortex in conjunction with prefrontal cortex.

5. The Pragmatic Value of Believing in Free Will

A totally different perspective on free will comes from social psychology in which human will is viewed as a kind of organ that is fuelled by willpower (Baumeister 2008). This perspective defines human will as a unitary concept that is characterized by specific properties. One central assumption of the *willpower metaphor* is that it draws on a common limited resource (Baumeister *et al.* 1998; Vohs and Schooler 2008). Tasks that require willpower include self-control, decision making, complex problem solving and conflict resolution. From this perspective there is not one task that measures the free will but rather a number of tasks that draw more or less on this resource. In a series of studies, Baumeister and colleagues could show that different tasks requiring willpower indeed interfere with each other (e.g., Baumeister *et al.* 1998; Muraven and Baumeister 2000). More specifically, they could show that carrying out a task that strongly relies on willpower leads to a depletion of this resource – this process is called *ego-depletion* and results in impaired performance in other tasks that rely on willpower. For instance, carrying out a self-control task leads to less persistence in a difficult problem solving task. Furthermore, making free choices to perform attitude relevant behavior also leads to reduced persistence in the problem solving task.

A second basic assumption of the willpower metaphor is that willed behavior is very effortful and requires more energy than behaviour that does not rely on willpower (Gailliot and Baumeister 2007; Gailliot *et al.* 2007). Support for the idea of higher energy requirements for processes involving willpower stems from the observation that such processes are very sensitive to the glucose level (Gailliot and Baumeister 2007).

Given that willed behaviour is so demanding, why do people put so much effort into their behaviour? Why do they spend so much energy to control themselves? Why do they behave responsibly instead of letting their automatic

[6] See Decety and Sommerville 2003 for a review.

and selfish impulses drive their actions? It has been demonstrated that increasing people's sense of responsibility can shift their behaviour toward a more desirable performance (Harmon-Jones and Mills 1999, Mueller and Dweck 1998). Under this perspective, one might expect that reducing people's sense of responsibility may promote undesirable behavior. What would happen if people start to believe that they have no control over their own actions? In other words, what would happen if people would be induced to believe the subjective experience of free will is completely illusional? To address this question, Vohs and Schooler (2008) carried out a study in which they examined whether inducing participants to believe that human behavior is predetermined would encourage cheating. Two groups of participants were exposed either to a deterministic (i.e., statements claiming that high-minded people now agree in that free will is an illusion) or to a neutral message (i.e., statements about consciousness which did not discuss free will). Afterwards, participants were given a series of mental-arithmetic problems. They were told that due to a computer glitch, the correct answer would appear on the screen while they were attempting to solve the problem and that they could stop the answer from being displayed by pressing the space bar after the arithmetical problem appeared. Furthermore, they were told that although the experimenter would not know whether they pressed the space bar, they should try to solve the problem honestly. Unbeknownst to the participants, the dependent measure was indeed the number of times they pressed the space bar to prevent the answer from appearing. Results showed that the participants who were exposed to a determinist message cheated more frequently than those who were exposed to a neutral message. In the same study, the authors showed that also when the task requires a more active behavior in order to cheat (i.e., stealing money from the researchers), participants exposed to a deterministic message behave more immorally than others.

Baumeister and colleagues (Baumeister *et al.* 2009) extended these findings into a broader context. More precisely, they showed that a disbelief in free will increases antisocial attitudes such as aggression and at the same time reduces pro-social behavior such as helpfulness.

These studies show that inducing a deterministic perspective that denies free will strongly influences human behaviour in social contexts. A simple exposure to a deterministic worldview increases the probability that people behave immorally and antisocially. What are the mechanisms underlying this

antisocial shift? Why do people behave antisocial if they are induced to believe that they are not free? According to Baumeister,

> Feelings of responsibility and accountability may make people feel that they ought to behave in socially desirable ways, such as performing prosocial acts of helping and restraining antisocial impulses to aggress against others. The deterministic belief essentially says that the person could not act otherwise, which resembles a standard form of excuse ("I couldn't help it") and thus might encourage people to act in short-sighted, impulsive, selfish ways. (Baumeister *et al.* 2009, p. 261)

Therefore a deterministic message acts as an implicit cue that let people behave in a selfish, impulsive, less altruistic, and aggressive fashion.

One alternative perspective of how beliefs about free will might affect social behaviour is to assume that disbelief in free will changes basic motor cognitive processes which in turn influence how we experience the consequences of our behaviour. Recently, the research group of Marcel Brass attempted to investigate the impact of disbelieving in free will on the preparation of intentional motor action. In particular, they applied the free will manipulation to study brain processes related to the preparation of voluntary movements. They could show that brain potentials that precede voluntary movements and that reflect the intentional involvement in action preparation, are strongly modulated by the level of disbelief in free will (Rigoni *et al.*, submitted). A potential explanation for this result is that the free will manipulation affects intentional involvement in the task via a reduction of self-efficacy beliefs. Less intentional involvement in an action might on the other hand reduce the feeling of agency for the consequences of the behaviour which in turn might alter our experience of responsibility for such actions. Although the specific mechanisms underlying this effect are not clear, these results suggest that abstract belief systems might have a an impact on very fundamental brain processes.

Whereas the studies in social psychology and cognitive neuroscience are crucial in showing the benefits of believing in free will at a societal level another question is how disbelieving in free will can influence individual well being. Promoting the idea that one has few control over his or her own behaviour has a strong impact on how individuals perceive themselves, for instance by lowering individual well-being and by increasing feelings of powerlessness and dissatisfaction.

Believing that we have free will or in other words that we have control over our own actions and over the environment thus seems to be a psychological and biological necessity.[7]

6. Conclusive Thoughts

The subjective feeling of free will is a pervasive component of human experience. We have a clear and unavoidable experience of voluntarily control a great part of our actions and we feel to be the *agent* of our behaviour. We therefore feel we are responsible for those actions that are performed with a conscious intention, that is, those actions that are associated with the subjective experience that "I" decided to do so. However, the *neuroscience of will* (Haggard 2008) has challenged this intuitive experience by questioning the role of free will as the generator of our actions. Here, we critically analyze the most important contributions that have threatened the existence of free will from a neuroscientific perspective. We commented that these studies will hardly provide an answer to the philosophical question of whether free will exists.

Furthermore, we outlined two additional perspectives on free will, namely, how people perceive free will in others and the pragmatic value of believing in free will. Both these frameworks are of great social relevance: human societies are ruled on the concept of *personal responsibility* and therefore it is assumed that people can freely decide their own actions. Understanding the mechanisms underlying the ability to perceive others' intentionality and how disbelief in free will alters basic brain processes, would shed light on several essential aspects of all human societies.

References

Banks, W. P., & Isham, E. A. (2009). We infer rather than perceive the moment we decided to act. *Psychological Science, 20*(1), 17-21.

[7] See Leotti *et al.* 2010 for a review.

Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego depletion: Is the active self a limited resource? *Journal of Personality and Social Psychology, 74*(5), 1252-1265.

Baumeister, R. F. (2008). Free will in scientific psychology. *Psychological Science, 3*(1), 14-19.

Beauchamp, M. S., Lee, K. E., Haxby, J. V., & Martin, A. (2002). Parallel visual motion processing streams for manipulable objects and human movements. *Neuron, 34*(1), 149-159.

Brass, M., Schmitt, R. M., Spengler, S., & Gergely, G. (2007). Investigating action understanding: Inferential processes versus action simulation. *Current Biology, 17*(24), 2117-2121.

Decety, J., & Sommerville, J. A. (2003). Shared representations between self and other: A social cognitive neuroscience view. *Trends in Cognitive Sciences, 7*(12), 527-533.

Dennett, D. (1987). *The Intentional Stance*. Cambridge, MA: MIT Press.

Frith, C. D. (1999). Interacting minds-A biological basis. *Science, 286*(5445), 1692-1695.

Gailliot, M. T., & Baumeister, R. F. (2007). The physiology of willpower: Linking blood glucose to self-control. *Personality and Social Psychology Review, 11*(4), 303-327.

Gailliot, M. T., Baumeister, R. F., DeWall, C. N., Maner, J. K., Plant, E. A., Tice, D. M., & Brewer, E. L. (2007). Self-control relies on glucose as a limited energy source: Willpower is more than a metaphor. *Journal of Personality and Social Psychology, 92*(2), 325-336.

Gallagher, S., & Zahavi, D. (2008). *The Phenomenological Mind: An Introduction to Philosophy of Mind and Cognitive Science*. London: Routledge.

Gallese, V., & Goldman, A. (1998). Mirror neurons and the mind-reading. *Trends in Cognitive Sciences, 2*(12), 493-501.

Gomes, G. (2010). Preparing to move and deciding not to move. *Consciousness and Cognition, 19*(1), 457-459.

Grossman, E. D., & Blake, R. (2002). Brain areas active during visual perception of biological motion. *Neuron, 35*(6), 1167-1175.

Haggard, P, & Eimer, M. (1999). On the relation between brain potentials and the awareness of voluntary movements. *Experimental Brain Research, 126*(1), 128-133.

Haggard, P. (2005). Conscious intention and motor cognition. *Trends in Cognitive Sciences, 9*(6), 290-295.

Haggard, P. (2008). Human volition: Towards a neuroscience of will. *Nature Reviews Neuroscience, 9*(12), 934-946.

Hallett, M. (2007). Volitional control of movement: The physiology of free will. *Clinical Neurophysiology, 118*(6), 1179-1192.

Hamilton, A. F. de C., & Grafton, S. T. (2006). Goal representation in human anterior intraparietal sulcus. *The Journal of Neuroscience, 26*(4), 1133-1137.

Hamilton, V. L. (1978). Who is responsible? Toward a social psychology of responsibility attribution. *Social Psychology, 41*(4), 316-328.

Harmon-Jones, E., & Mills, J. (1999). *Cognitive Dissonance: Progress on a pivotal theory in social psychology*. Washington, DC: American Psychological Association.

Hauser, M. (2006). *Moral Minds: How Nature Designed Our Universal Sense of Right and Wrong*: New York: Ecco Press.

Heider, F. (1958). *The Psychology of Interpersonal Relations*. New York: Wiley.

Keysers, C., & Gazzola, V. (2007). Integrating simulation and theory of mind: From self to social cognition. *Trends in Cognitive Sciences, 11*(5), 194-196.

Kornhuber, H. H., & Deecke, L. (1965). Hirnpotentialänderungen bei Willkürbewegungen und passiven Bewegungen des Menschen: Bereitschaftspotential und reafferente Potentiale. *Pflügers Archiv European Journal of Physiology, 284*(1), 1-17.

Kühn, S., & Brass, M. (2009). Retrospective construction of the judgement of free choice. *Consciousness and Cognition, 18*(1), 12-21.

Lau, H. C., Rogers, R. D., & Passingham, R. E. (2007). Manipulating the experienced onset of intention after action execution. *Journal of Cognitive Neuroscience, 19*(1), 81-90.

Leotti, L. A, Iyengar, S. S., & Ochsner, K. N. (2010). Born to choose: The origins and value of the need for control. *Trends in Cognitive Sciences, 14*(10), 457-463.

Libet, B., Gleason, C. A, Wright, E. W., & Pearl, D. K. (1983). Time of conscious intention to act in relation to onset of cerebral activity (readiness-potential). The unconscious initiation of a freely voluntary act. *Brain, 106*, 623-642.

Liepelt, R., Cramon, D. Y. V., & Brass, M. (2008). What is matched in direct matching? Intention attribution modulates motor priming. *Journal of Experimental Psychology. Human Perception and Performance, 34*(3), 578-591.

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology, 75*(1), 33-52.

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126*(2), 247-259.

Pockett, S., & Miller, A. (2007). The rotating spot method of timing subjective events. *Consciousness and Cognition, 16*(2), 241-254.

Rawls, J. (1971). *A Theory of Justice*. Cambridge, MA: Harvard University Press.

Rigoni, D., Brass, M., & Sartori, G. (2010). Post-action determinants of the reported time of conscious intentions. *Frontiers in Human Neuroscience, 4*, 38.

Rigoni, D., Kuhn, S., Sartori, G., & Brass, M. (submitted). Inducing disbelief in free will alters brain correlates of preconscious motor preparation.

Rizzolatti, G., Fadiga, L., Gallese, V, & Fogassi, L. (1996). Premotor cortex and the recognition of motor actions. *Brain Research. Cognitive Brain Research, 3*(2), 131-141.

Roskies, A. L. (2010). How does neuroscience affect our conception of volition? *Annual Reviews of Neuroscience, 33*, 109-130.

Shibasaki, H, Barrett, G., Halliday, E., & Halliday, A. M. (1980). Components of the movement-related cortical potential and their scalp topography. *Electroencephalography and Clinical Neurophysiology, 49*(3-4), 213-226.

Shibasaki, H., & Hallett, M. (2006). What is the Bereitschaftspotential? *Clinical Neurophysiology, 117*(11), 2341-2356.

Soon, C. S., Brass, M., Heinze, H.-J., & Haynes, J.-D. (2008). Unconscious determinants of free decisions in the human brain. *Nature neuroscience, 11*(5), 543-545.

Trevena, J., & Miller, J. (2010). Brain preparation before a voluntary action: Evidence against unconscious movement initiation. *Consciousness and Cognition, 19*(1), 447-456.

Uddin, L. Q., Iacoboni, M., Lange, C., & Keenan, J. P. (2007). The self and social cognition: The role of cortical midline structures and mirror neurons. *Trends in Cognitive Sciences, 11*(4), 153-157.

Vohs, K. D., & Schooler, J. W. (2008). The value of believing in free will: Encouraging a belief in determinism increases cheating. *Psychological Science, 19*(1), 49-54.

Wegner, D. M., & Wheatley, T. (1999). Apparent mental causation. Sources of the experience of will. *The American Psychologist, 54*(7), 480-492.