

## **Exploring Free Will in the Laboratory**

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In 2011, Florida became one of the international centers of inquiry into free will, when the Templeton Foundation gave a center grant to Alfred Mele, a professor of philosophy at Florida State. That grant is the basis for facilitating the efforts by thinkers and researchers around the world to understand free will, as well as making some effort to coordinate their efforts and bring both scientific observation and philosophical rigor to the collective inquiry. Surveys show that most people believe in free will to some extent. Is this belief justified? In what sense do people have free will? If there is such a thing, how does it work? If there is no such thing, why do people believe in it, and how is this mistaken belief sustained? These are profound questions that address fundamental concerns about human nature, science, religion, and everyday life.

Such questions appeal to me. One theme of my career has been to bring the methods and findings of social science

research to bear on a series of grand philosophical questions. The past century has seen the scientific method applied to an ever wider range of human activities. We now have mountains of data collected by psychologists, economists, sociologists, anthropologists, and others. These furnish an exciting new basis for thinking about the basic questions that wise men and women have debated for centuries.

My training was in experimental social psychology. In my laboratory at Florida State University, we conduct experiments and surveys designed to uncover systematic patterns in how people think, feel, act, and interact. For the past few years, some of those studies have focused on these questions of free will. It is not likely that an experiment is going to prove or disprove the existence of free will. But we can learn a great deal about how people guide their actions, control themselves, and make decisions — as well as how people understand free will and what effect these beliefs have.

In other words, this article (like my research program) is not about trying to define free will, or about trying to prove its existence or nonexistence. Rather, I have been seeking to pull together scientific facts

and findings to ascertain what the reality is behind the idea of free will. The goal is to establish what it is people actually have and do. My research at Florida State University has been studying actual behavior along the lines of self-control, rational choice, planning, and initiative. If free will really exists, it is almost certainly contained in those phenomena. If free will does not exist, then those sorts of actions are the ones that give rise to the pervasive illusion of free will.

### **Questioning Free Will**

The idea of free will has come under fire from many perspectives. Intuitively, most people have the sense that they consciously decide and control their actions, and that intuitive sense is one basis for the belief in free will. Yet research has shown that that belief is sometimes mistaken. Whether it is *always* mistaken is a very different question, requiring levels of evidence far beyond what is now available, but the fact that it is sometimes mistaken has emboldened skeptics to suggest that there may be no such thing as free will.

One source of skepticism is unconscious causation. Dating back at least to Freud, psychologists have shown that people's reactions are often shaped by

factors of which they are unaware. Careful lab studies have shown that subliminal messages do influence people's reactions. The conscious self is not fully in charge, even though it may assume and feel that it is.

Another source of skepticism toward free will is the belief that the entire universe is governed by powerful, immutable laws of physics. Centuries ago, the French mathematician Pierre LaPlace proposed that if someone knows the position of every physical thing (every particle) in the universe and all the laws of nature, one could predict the future with 100% accuracy. Many experts today still find this worldview appealing. If reality is ultimately just a matter of electrons obeying physical forces and chemical reactions, what difference could free will possibly make? In LaPlace's account (which gave rise to the theory of determinism), there is only one possible outcome from any given situation, and the future is every bit as fixed and unchangeable as the past.

Recent work in brain science has encouraged this deterministic sort of thinking. Some famous experiments by Benjamin Libet (1985, 2004) showed that brain activity increased just before people

made a conscious decision to move a finger. To some, those findings suggest that action starts in the unconscious brain and the conscious decision is a mere rubber-stamp, rather than being a genuine cause.

Other brain researchers have come to think that free will is impossible based on the following line of argument (e.g., Greene and Cohen 2004). Human action is caused by the brain. The brain operates by means of electrical activity in brain cells. Whether a brain cell fires depends entirely on chemical and electrical processes. These are purely physical events with no room for free will, so there can be no free will in the causation of human action.

For the record, I have come to think that all these arguments have flaws and holes. But many people accept them. It is easy to see why they threaten people's belief in free will: They create an image of a conscious self that imagines it is in charge but is merely a puppet or side effect of strict, rigid causal processes operating outside of human consciousness. Certainly these arguments and findings deserve to be respected and considered carefully. Hence one goal of my work is to try to formulate a scientifically viable theory of free will that will take these findings into account but

nonetheless preserve the reality of choosing among different options that are genuinely possible. This brings up the issue of defining free will.

### **What is Free Will?**

The term *free will* unfortunately carries many different meanings, and different people understand it in different ways. Therefore, many debates about free will are not proper debates, because the different sides are not talking about the same thing. They object to their opponents' beliefs without understanding those beliefs.

As already indicated, my goal is to ascertain whether it is possible to formulate a scientific theory of free will. As a scientific theory, it does not involve anything that is supernatural, though some views of free will stress such supernatural entities. Likewise, to some people, free will means freedom from causality. In my view, a scientific theory is a causal theory, and so my account of free will does not involve an exemption from causality. (Rather, I consider free will to be a special kind of cause. There are, after all, a great many different kinds of causes, so it seems reasonable to suggest that a few of them may be peculiar to conscious, symbol-using, logical, culturally competent animals.)

The essence of free will, in my view, is that a person could act in different possible ways. To accept free will is to believe that a human being really does make choices, in the sense that one confronts a situation with multiple possible outcomes, and one acts to make one outcome real and the other possibilities are denied. Freedom is a matter of degree: It is freedom from some particular causes, or kinds of causes. Typically free will involves the ability to *consciously* consider the multiple options and select the best one (and execute it). In particular, it means overcoming the reinforcement learning and instinct patterns that drive much animal behavior, so that a human being can act like a civilized, rational, moral person instead of a laboratory rat or monkey. That freedom involves incorporating logic, cultural ideas, symbols, rules, and other considerations into the causation of one's action.

For example, letting moral sentiments and moral rules influence one's actions would be one form of free will. Kant was an early advocate of the view that free action meant acting based on morality (1797, 1967). Morality seems inconceivable without embracing the assumption that different actions are possible in the same situation; if a person could not have acted

any differently than he or she did, the person's moral responsibility is greatly reduced or eliminated. Moral rules specify that it is right to act one way rather than another, which again assumes that both are possible.

When the FSU Center for the Study of Free Will was established, one of Mele's first products was a Lexicon of terms, prepared by a committee and intended to facilitate the exchange of ideas by promoting common understandings (Haggard, Mele, O'Connor, and Vohs 2010). Hence it is useful to invoke the definition of free will as provided in the Lexicon.

Free will is defined as the ability to perform free actions. The latter are defined in two ways. One is "any intentional action performed on the basis of informed, rational deliberation by a sane person in the absence of compulsion and coercion" (Haggard et al. 2010). The second, more obscure definition is that it assumes that the laws of nature permit multiple possible actions within the same situation, thus entailing the falseness of determinism. The Lexicon noted that there may be additional requirements in the second definition. The difference between the two of them is based on whether they are

compatible with deterministic causality. As I have suggested, however, it may be most useful to regard free will as a kind of causality, and one that goes beyond laws of physics to encompass psychological, cultural, and other meaningful factors. It does not violate natural law but is not reducible to it, in much the same way that one cannot explain the causes of the First World War or of the subprime mortgage crisis and international banking downturn of 2008 in terms of chemical reactions and/or subatomic processes.

The fact that one cannot explain free will by subatomic physics is important. I have said that free will can be understood as a kind of causality. What kind? A simple answer is “emergent.” Many causes (such as macroeconomic processes) only come into being in large systems and cannot be found in the single parts. Life itself is a useful example. The atoms that make up a living person’s body are the same ones there when the person is dead. Life is not found in the atoms themselves but only at a high level of organization of those atoms.

Emergence is part of what is missing in those earlier arguments against free will, such as the ones that seek to explain human action by brain activity. The brain cells are

firing or not, in coordinated patterns, because of a meaningful event that is happening in social environment. The brain activity is only one set of steps in a causal chain.

Hence let me say to the most rigorous or picky readers, to be precise, free will is a level of self-organization, presumably a rather high one. Living things self-organize in the sense that they demarcate a boundary between themselves and the physical environment. Agentic animals do more than that: they move about as a unit, for example. Free will would be yet a higher level of autonomy, in which multiple causes are interacting within an autonomous system to produce action based on the interests of that system.

### **Freedom and Evolution**

A scientific theory would presumably understand free will as a kind of action control process. If humans have it, then we presumably got the capability for it from evolution. If free will is largely unique to humans, then it is important to look closely at what made human evolution distinctive. This has important implications for how to understand free will. It indicates

what the environmental pressures were that selected one kind of action control system over another, and thus shaped how free will evolved.

To some people, free will means doing something at random, for no reason. I do not find this definition helpful. Acting at random and without reason is not likely something that would have appeared in human evolution. If a baby were born with a genetic mutation that made it capable of acting in completely random ways, independent of all prior events and external facts, would that baby survive and reproduce better than its peers? It is hard to see how. There is not much adaptive benefit gained by random action. Indeed, human society generally does not really approve of people acting in random ways. Faced with someone acting in seemingly random ways, people will ask, what are you doing, and why are you doing it? Instead, I think the capacity for free will probably evolved to produce meaningful actions that can bring benefits within the human form of social life (i.e., culture).

Culture is another term that is understood in different ways. In my usage, culture is essentially a system of how people can live and work together. I have argued

elsewhere, and at length, that culture is humankind's biological strategy, which is to say it is how the human species deals with the basic problems of survival and reproduction that confront all living things (Baumeister 2005). Culture makes life better for groups of people if, and only if, people mostly follow its rules. Hence let me suggest that *free will is for following rules*, at least to some extent.

To be sure, some readers may be inclined to object to the idea that free will is for following rules. They might think of freedom as being able to do whatever you want, with no rules. But that is wrong. Any animal out in the forest is capable of doing what it wants, without rules. Evolution did not need to produce any new capability to enable humans to do likewise. More to the point, free will is not needed for doing whatever you feel like. Rather, humans needed a new way of controlling their actions that would enable them to operate within a complicated social system that functions only insofar as people generally follow its rules (such as laws, social norms, and moral principles). A successful human being manages to get what he or she wants while following the rules of the system. The ability to do that, indeed in highly complex systems with multiple layers of abstract

rules, is one remarkable psychological advance that sets humans apart from other species.

#### **Four Sorts of Actions**

Instead of random action, let me suggest four kinds of actions that I regard as important forms or manifestations of free will. Unlike random action, these are all highly adaptive for enabling a human being to survive and reproduce (even to prosper and flourish) within a cultural society. They point to advanced psychological capacities beyond what most animals can muster.

The first is self-control. This is the basic capacity to change one's behavior to conform to rules, goals, norms, expectations, and other ideas. Animals who wish to live in culture must possess self-control.

Incidentally, it was research on self-control that brought me to the topic of free will. I had been conducting research on self-control for over a decade before the issue of free will surfaced.

The second is rational, intelligent choice. This involves being able to decide how to act based on a thoughtful comparison of multiple options and the likely consequences of actions, in the context of pursuing one's enlightened, long-term self-

interest. It is very much not how behaviorists contended that animals choose, based on reinforcement history, and in that sense it represents an important advance and a valuable sort of freedom.

Planning is the third. Humans are exceptional in their capacity to develop ad hoc plans and follow them. Each day may be different from any other, and yet a person can think out a plan for how best to carry out a series of activities (that may be unrelated to each other) and then execute it. Social coordination is also important. Human groups, unlike other groups, often perform group tasks by meeting to make plans. They discuss various options for how to work together to achieve their goals. The plans are refined by these discussions, and then the people carry them out. It was precisely this sort of planful group activity that made humans the most successful hunters in nature, despite the absence of fangs, venom, overpowering strength, wings, and other natural weapons.

Initiative may be a fourth. At present the study of initiative as an aspect of free will is quite preliminary. But the capacity to respond actively rather than passively, and to initiate actions rather than just responding to events, may also be an important element

in free will.

### **A Common Basis**

One can search the philosophical literature on free will and find references to all four of the behavior types I have mentioned (self-control, rational choice, planful action, and initiative). What can a social psychologist contribute? Psychology experiments can reveal causal processes to show how things operate. In terms of free will, my work has shown that these four behaviors have a common underlying basis. Hence it is appropriate to group them together under one umbrella term, such as free will.

As I said, I came to this problem as a self-control researcher. When I began my work on that topic, psychology was heavily dominated by information-processing theories that compared the human mind to a computer. There was no interest in talking about energy processes and other such notions, which at the time were considered archaic relics of the Freudian era. Yet our lab work began to produce findings that called for energy theories rather than pure information-processing ones.

Indeed, we started our work on self-control with three competing theories, which

we had gleaned from an exhaustive survey of the research literature. One was the information-processing view: self-control is simply a matter of figuring out what is the appropriate way to change one's actions, and then doing it. Another was the folk notion of willpower, probably based on the subjective impression that it takes some kind of strength or power to resist temptation. The third came from research on child psychology, which tends to conceptualize human development as "acquiring skills." In this perspective, self-control would be a skill that children gradually acquire as they become socialized and learn how to behave.

How would one pit those theories against each other? A social psychologist looks for situations in which the competing theories would make different predictions and then seeks to create those situations in the lab. The three theories make different predictions as to what would happen if people exerted self-control in some way and then, not long afterward, encountered another but different sort of demand for self-control. The information-processing theory predicts that people would perform better on the second task (compared to people who skipped the first task). That is because the first task should make all the relevant processing systems active — rather like how

your computer is faster at executing another task with the same program that is already up and working. Many studies have shown that if some sort of mental activity is activated, then the person does better at new tasks that use the same sort of mental activity or idea (e.g., Higgins and King 1981; Srull and Wyer 1979).

In contrast, the willpower notion suggests that there is some sort of energy or strength that would be used by the first task, leaving less available for the second task. Therefore people should do worse on the second task as a result of having depleted their strength on the first. Last, skill remains essentially the same from one trial to the next, but increases gradually over time with many trials. A baseball player does not have any more skill when coming to bat in the fourth inning than when batting in the second, but he or she may gain batting skill from a great many turns at bat.

We conducted dozens of experiments with that sort of design. Invariably, the results favored the willpower theory. One of the best-known demonstrations was run on college students who had been asked to refrain from eating anything for three hours before the study (so they arrived hungry). To exercise their self-control, we exposed them

to temptation. They came to a lab room filled with the delicious aroma of freshly baked chocolate chip cookies. They were seated at a table on which was a tray of these cookies, along with other enticing chocolates and candies. Also on the table was a bowl of radishes. By random assignment, some of them were told that their assignment was to eat radishes (ostensibly as part of a study on memory for taste) and to leave the cookies and chocolates for other research subjects. Then we left them alone for five minutes.

We had two control conditions. Some research participants were told to eat the cookies and leave the radishes. Others were given no food at all. But the crucial condition was the one that required people to use their willpower to resist temptation. They had to sit there seeing, smelling, and wanting the cookies — but nonetheless had to leave them untouched and eat the radishes instead. (We secretly observed them to monitor compliance with instructions. People did manage, though just barely, to resist the temptation.)

Afterward we took each person to a separate room, with no food around, and measured their self-control on a completely different, ostensibly unrelated task. This was

borrowed from stress research and involved seeing how long people would work at a difficult, frustrating puzzle before giving up. The people in the radish condition gave up much faster than those in the two control conditions (Baumeister, Bratslavsky, Muraven, and Tice 1998).

Thus, resisting the temptation to eat the cookies took *something* out of them, leaving them less willing and able to persevere in the face of failure. Over time, we have come to accept that this *something* is the psychological reality behind the folk notion of willpower.

The concept of free will entered into our laboratory discussions and theorizing when we found that the same energy resource used for self-control was also used for rational, intelligent thought. Multiple sets of experiments established this link. One of them showed that people's intelligence dropped (temporarily) in the aftermath of exerting self-control (Schmeichel, Vohs, and Baumeister 2003). That is, after people depleted their willpower doing simple tasks like controlling their attention or overriding habits, their IQ scores dropped. Apparently willpower is needed for some (not all) forms of intelligent thought. Logical reasoning,

extrapolating, and complex comprehension of reading passages were all impaired. In contrast, rote memory and other automatic processes remained intact.

Another set of studies showed that decision making depletes willpower (Vohs et al. 2008). In these studies, we had people make a series of choices, like confronting many pairs of consumer items and saying which one they would prefer to have. Afterward, these people did worse on laboratory tests of self-control (such as holding your hand submerged in ice water) than people who had merely looked at the same products and rated them but not made any selections. A third set of studies showed that after acts of self-control, decision making tends to shift toward simpler, more easily biased, low-effort modes of deciding (Pocheptsova, Amir, Dhar, and Baumeister 2010).

A recent series of studies has shown that the state of depleted willpower makes people become relatively passive (Vohs and Baumeister 2010). Initiative thus seems to fluctuate with one's level of willpower.

Last, our work on planning has just begun, but work in other labs has already shown that having firm plans can help people resist some of the deleterious effects

of depleted willpower (Webb and Sheeran 2003).

The upshot of this line of research has been to show that the four forms of free will that we identified — self-control, rational choice, initiative, and planful behavior — all draw on a common resource with a common psychological process. Hence it is appropriate to think of them as different aspects of one broad kind of process. For cautious scientists with a fondness for jargon, a term such as “executive function” would be suitable. In popular parlance, “free will” is the familiar term.

In fact, our work has begun to uncover a common physiological basis for these effects (Gailliot, Baumeister, DeWall, Maner, Plant, Tice, Brewer, and Schmeichel 2007; Masicampo and Baumeister 2008). Glucose is a chemical in the bloodstream. It is made from the food the body consumes, and it furnishes fuel for the brain as well as muscles and other activities. In essence, it is the human body’s energy supply. We have found that glucose levels drop when people exert self-control, and that low levels of glucose predict poor performance on lab tests of self-control. We have also found that giving people a quick dose of glucose — a

glass of lemonade sweetened with sugar — restored performance even after people had depleted their willpower by preliminary exertions of self-control. Lemonade sweetened with Splenda (a diet sweetener that delivers no glucose) had no effect. The two lemonades taste the same, and nobody knew whether they had been served lemonade made with sugar or Splenda, but only the people who consumed sugar recovered from their state of depleted willpower in time to perform well on the next test.

#### A Second Look at Random Action

I must acknowledge that some recent contributions have pushed me to reconsider whether there might be another form or aspect of free will that does look like a random action generator. Earlier I said that the evolution of random behavior seemed an unlikely hypothesis, because human society has very little use for random behavior. But Brembs (2010) has argued convincingly that much earlier in evolution, creatures had some benefit from being a little bit unpredictable, even in the form of occasionally producing something new at random. Indeed evolution itself operates by genetic mutation, which is a process of random change that may be bad for the

individual but helps the species survive when the environment changes. Simonton (1999) has argued that creativity may follow a similar process: the mind throws up random ideas, which are then selected among. Brembs pointed out that highly predictable creatures are also highly vulnerable to predators, so there is some benefit to occasionally being different.

Likewise, Skinnerian learning (and possibly Pavlovian conditioning) depends entirely on random behavior, which is done more or less at random and then either rewarded (reinforced) or punished. There was also some research published in 2007 that got ample media attention for claiming that fruit flies had free will, on the basis of a seemingly random action they performed, changing direction in a completely dark and empty environment, so no external stimulus prompted them to change the direction they were flying. Brembs (2010) was one of the authors of that work, which then led him to formulate his fuller theory of free will as a biological adaptation.

Any form of ostensibly free will that is present in fruit flies and lab rats cannot be a very exalted or advanced form of free will. Presumably what humans have is something more. But the human version could build on

an inherited, simpler animal tendency to abandon standard procedure once in a while and do something new, more or less at random. In animals, the simple tendency would produce the random variations needed for evolution and learning. In humans, this might become combined with an understanding of culture that enables people to initiate new, meaningful ventures or creative solutions.

### **Belief in Free Will**

A remarkable article by two psychologists, Kathleen Vohs and Jonathan Schooler (2008), reported a series of studies that took a novel approach to the question of free will. Instead of contributing to the ongoing debate as to whether or in what sense people might have free will, they studied the effects of believing vs. disbelieving in it. To do this, they created two groups with different levels of average belief in free will. In different studies, they did this in different ways. They had some people read an essay by Sir Francis Crick ridiculing the idea of free will as obsolete, unscientific nonsense (while others in the control condition read a neutral essay that said nothing about free will). Or they had people read and ponder a series of statements designed to promote or decrease

belief in free will. Of course, experimental manipulations like these will not convert a staunch believer in free will into a committed disbeliever. But they do shift people some way along the continuum, which is sufficient for exploring the effects of relatively greater versus lesser belief in free will.

The effects of belief in free will were eye-opening. People who were induced to disbelieve in free will were more willing than others to cheat and steal. For example, in some studies people were given a difficult test of general knowledge and told that they would earn money for every correct answer. They were then permitted to score their own sheets and report how many they got right (and hence how much money they earned). The test sheets were shredded, which convinced people that no one would be able to know whether they had claimed more correct answers than they had really made. Disbelievers in free will showed an implausible increase in the number they claimed they had gotten correct — but only if they thought no one could check on them.

Inspired by these findings, my graduate students and I adapted those procedures to run a series of investigations examining other effects of believing versus

disbelieving in free will (e.g., Baumeister, Masicampo, and DeWall 2009). Our results have extended the original findings about cheating. People who disbelieve in free will behave more aggressively toward other people, as compared to those who believe in free will. They are less willing to help others in need. They conform to the opinions of others rather than thinking for themselves. They learn fewer lessons from their own misdeeds, and the lessons are of poorer quality (as rated by independent observers). They have less happiness and find life less meaningful. When reflecting on personal experiences in which they hurt another person, they generate fewer thoughts of how they might have acted differently.

Regardless of whether one believes people have free will, these findings suggest why most laypersons believe in it, and why societies might well encourage such belief. Belief in free will tends to support actions that are good for culture and society — actions in which people can overcome their short-term self-interest and act in ways that promote social cooperation and harmony. There is some evidence that the link to moral responsibility is at least partly responsible for these behavioral effects. That is, belief in free will promotes a sense of moral responsibility, which in turn causes

people to act in morally desirable ways.

Again, these findings shed no light on the question of whether free will actually exists. People may believe plenty of things that are false. Nonetheless, they are also quite conducive to the argument that the idea of free will is linked to some genuine changes in the psychology of personal action control that evolved for the purpose of enabling human animals to function effectively within a cultural society. If the opposite findings had emerged — namely, that believing in free will led people to act in selfish, antisocial ways — it would be hard to maintain the theory that free will evolved for the purpose of enabling people to act in ways that would make their cultural systems operate effectively for the general good.

### **Conclusion**

There is an important social reality that goes by the name of free will. Whether it deserves to be called free will is a different and difficult question, and the answer may depend on which of the various definitions of free will that one selects. Nonetheless, there are ample empirical realities worthy of scientific study. People generally believe in free will, albeit to varying degrees and in assorted ways. Their degree of belief in free will has behavioral

consequences, with high levels of belief in free will generally linked to behaving in ways that help cultural society to function properly. A broad and diverse set of behaviors is widely associated with the idea of free will, and those behaviors do have some common psychological and physiological processes, including depending on a limited energy resource (corresponding partly to the folk notion of willpower) and levels of glucose in the bloodstream. These behaviors include self-control, rational choice, planful behavior, and initiative.

To me, part of the excitement of this work is that it is beginning to seem possible to produce a scientific theory that integrates self-control, rational choice, planful behavior, and initiative, and potentially a couple other categories of behavior as well. Such a theory would regard free will as an advanced form of action control, most likely the result of evolutionary processes. Human free will presumably evolved from the simpler forms of agency found in many animals and was shaped by the distinctive forces that came into play during human evolution. These would likely have shaped free will to be especially useful for the special kinds of social life that humans have developed, including culture (understood as

a form of social that uses shared meanings and communication of information, systems with complementary roles for cooperative division of labor, social and economic exchange, and moral responsibility).

A scientific theory would presumably not regard free will as exemption from causality or as random action. Rather, a scientific theory would treat free will as a special kind of causality that is peculiar to self-aware members of cultural societies who can direct their own behavior based on integrative calculations of enlightened self-interest, socially shared ideas, and mental simulation of alternative courses of action (including their consequences).

Again, I do not claim that this proves the reality of free will. Rather, it may be more appropriate to think of this as the reality behind the popular idea of free will. Depending on which definition of free will one uses, this is either the genuine form of free will or the actual phenomenon that is mistaken for it. Either way, it is a vital part of being human.

## References

- Baumeister, R.F. 2005. *The Cultural Animal: Human Nature, Meaning, and Social Life*. New York: Oxford University Press.
- Baumeister, R.F., Bratslavsky, E., Muraven, M., and D.M. Tice. 1998. "Ego Depletion: Is the Active Self a Limited Resource?" *Journal of Personality and Social Psychology* 74: 1252-1265.
- Baumeister, R.F., Masicampo, E.J., and C.N. DeWall. 2009. "Prosocial Benefits of Feeling Free: Disbelief in Free Will Increases Aggression and Reduces Helpfulness." *Personality and Social Psychology Bulletin* 35: 260-268.
- Brembs, B. "Towards a Scientific Concept of Free Will as a Biological Trait: Spontaneous Actions and Decision-making in Invertebrates." *Proceedings of the Royal Society B: Biological Sciences*, 2010. Published online doi: 10.1098/rspb.2010.2325.
- Gailliot, M.T., Baumeister, R.F., DeWall, C.N., Maner, J.K., Plant, E.A., Tice, D.M., Brewer, L.E., and B.J. Schmeichel. 2007. "Self-control Relies on Glucose as a Limited Energy Source: Willpower is More than a Metaphor." *Journal of Personality and Social Psychology* 92: 325-336.
- Greene, J., and J. Cohen. 2004. "For the Law, Neuroscience Changes Nothing and Everything." *Philosophical Transactions of the Royal Society of London B* 359: 1775-1785.
- Haggard, P., Mele, A., O'Connor, T., and K. Vohs. 2010. "Lexicon of Key Terms." Big Questions in Free Will Project, 2010. <http://www.freewillandscience.com>.
- Higgins, E. T., and G.A. King. 1981. "Accessibility of Social Constructs: Information Processing Consequences of Individual and Contextual Variability," in *Personality, Cognition, and Social Interaction*, eds. N. Cantor & J. Kihlstrom. Hillsdale, NJ: Erlbaum, 69-121.
- Kant, I. 1967. "*Kritik der Praktischen Vernunft* [Critique of Practical Reason], 1797. Hamburg, Germany: Felix Meiner Verlag.
- Libet, B. 1985. "Unconscious Cerebral Initiative and the Role of Conscious Will in Voluntary Action." *Behavioral and Brain Sciences* 8: 529-566.
- Libet, B. 2004. *Mind Time: The Temporal Factor in Consciousness*. Cambridge, MA: Harvard University Press.
- Masicampo, E.J., and R.F. Baumeister. 2008. "Toward a Physiology of Dual-process Reasoning and Judgment: Lemonade, Willpower, and Expensive Rule-based Analysis." *Psychological Science* 19: 255-260.
- Pocheptsova, A., Amir, O., Dhar, R., and R.F. Baumeister. 2009. "Deciding Without Resources: Resource Depletion and Choice in Context." *Journal of Marketing Research* 46: 344-355.
- Schmeichel, B. J., Vohs, K. D., and R.F. Baumeister. 2003. "Intellectual Performance and Ego Depletion:

- Role of the Self in Logical Reasoning and Other Information Processing.” *Journal of Personality and Social Psychology* 85: 33-46.
- Simonton, D. K. 1999. “Creativity as Blind Variation and Selective Retention: Is the Creative Process Darwinian?” *Psychological Inquiry* 10: 309-328.
- Srull, T.K., and R.S. Wyer, Jr. 1979. “The Role of Category Accessibility in the Interpretation of Information about Persons: Some Determinants and Implications.” *Journal of Personality and Social Psychology* 37: 1660-1672.
- Vohs, K.D., and R.F. Baumeister. 2010. *Initiative Uses Self-control Resources for Active, Instead of Passive, Behavior*. Manuscript submitted for publication, University of Minnesota, 2010
- Vohs, K. D. and J.W. Schooler. 2008. “The Value of Believing in Free Will: Encouraging a Belief in Determinism Increases Cheating.” *Psychological Science* 19: 49 - 54.
- Vohs, K.D., Baumeister, R.F., Schmeichel, B.J., Twenge, J.M., Nelson, N.M., and D.M. Tice. 2008. “Making Choices Impairs Subsequent Self-control: A Limited Resource Account of Decision Making, Self-Regulation, and Active Initiative.” *Journal of Personality and Social Psychology* 94: 883-898.
- Webb, T.L., and P. Sheeran. 2003. “Can Implementation Intentions Help to Overcome Ego-depletion?” *Journal of Experimental Social Psychology* 39: 279-286.