

## SUPPLEMENTARY MATERIALS:

### Replications not reported in Main Text

Effect	Reported in Manuscript	Not reported in Manuscript	
	Predicted effects	Successful replications	Unsuccessful replication attempts
Correlation between Free Will and Retributivism	Study 1 – using mechanical turk sample	Using yourmorals.org sample	
Anti-free will argument reduces Retributivism	Study 2 – using lab sample	Using lab sample	
Neuroscience articles reduce Retributivism	Study 3 – using lab sample	Using mechanical turk sample	Using mechanical turk sample
Cognitive neuroscience class reduces Retributivism	Study 4 – using college class sample		

### Experimental Manipulations from Studies 2 and 3:

#### **STUDY 2**

##### **Anti-Free Will Condition**

###### *A Postscript on Free Will*

*“You,” your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules. Who you are is nothing but a pack of neurons.*

*Most religions hold that some kind of metaphysical free will exists that, to some degree, embodies the essence of that human being. Religions may not have all the same beliefs, but they do have a broad agreement that people have free will.*

*Yet the common belief of today has a totally different view. It is inclined to believe that the idea of free will, distinct from neuronal activity and not subject to our known*

*scientific laws, is a myth. It is quite understandable how this myth arose without today's scientific knowledge of nature of matter and radiation, and of biological evolution. Such myths seem only too plausible. For example, four thousand years ago almost everyone believed the earth was flat. Only with modern science has it occurred to us that in fact the earth is round.*

*From modern science we now know that all living things, from bacteria to ourselves, are closely related at the biochemical level. We now know that many species of plants and animals have evolved over time. We can watch the basic processes of evolution happening today, both in the field and in our test tubes and therefore, there is no need for the metaphysical concept of free will to explain the behavior of humans and other animals. In addition to scientists, many educated people also share the belief that free will is a metaphor.*

*Most people take free will for granted, since they feel that usually they are free to act as they please. Three assumptions can be made about free will. The first assumption is that part of one's brain is concerned with making plans for future actions, without necessarily carrying them out. The second assumption is that one is not conscious of the "computations" done by this part of the brain but only of the "decisions" it makes – that is, its plans, depending of course on its current inputs from other parts of the brain. The third assumption is that the decision to act on one's plan or another is also subject to the same limitations in that one has immediate recall of what is decided, but not of the computations that went into the decision.*

*So, although we appear to have free will, in fact, our choices have already been predetermined for us and we cannot change that. The actual cause of the decision may be clear cut or it may be determined by chaos, that is, a very small perturbation may make a big difference to the end result. This would give the appearance of the Will being "free" since it would make the outcome essentially unpredictable. Of course, conscious activities may also influence the decision mechanism.*

*One's self can attempt to explain why it made a certain choice. Sometimes we may reach the correct conclusion. At other times, we will either not know or, more likely, will confabulate, because there is no conscious knowledge of the 'reason' for the choice. This implies that there must be a mechanism for confabulation, meaning that given a certain amount of evidence, which may or may not be misleading, part of the brain will jump to the simplest conclusion.*

## **Neutral Condition**

### *The General Nature of Consciousness*

*Psychologists have shown that common sense ideas about the working of the mind can be misleading. When psychology began as an experimental science, in the latter part of*

*the nineteenth century, there was much interest in consciousness. It was hoped that psychology might become more scientific by refining introspection until it became a reliable technique.*

*Since the problem of consciousness is such a central one, and since consciousness appears so mysterious, one might have expected that psychologists and neuroscientists would now direct major efforts toward understanding it. This, however, is far from being the case. The majority of modern psychologists omit any mention of the problem, although much of what they study enters into consciousness. Most modern neuroscientists ignore it.*

*The American psychologist, William James, discussed consciousness in his work 'The Principles of Psychology' (1898), and described five properties of what he called "thought". Every thought, he wrote, tends to be part of personal consciousness. Thought is always changing, is sensibly continuous, and appears to deal with objects independent of itself. In addition, thought focuses on some objects to the exclusion of others. In other words, it involves attention. Of attention he wrote, "It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. It implies withdrawal from some things in order to deal effectively with others."*

*Many psychologists believed that some processes are subliminal or subconscious. For example perception was similar in its logical structure to what we normally mean by inference, but that it was largely unconscious. Three basic ideas of consciousness were developed. Firstly, not all the operations of the brain correspond to consciousness. Secondly, consciousness involves some form of memory, probably a very short term one. Thirdly, consciousness is closely associated with attention.*

*Unfortunately, a movement arose in academic psychology that denied the usefulness of consciousness as a psychological concept. This was partly because experiments involving introspection (which involves thinking about what one is thinking) did not appear to be leading anywhere and partly because it was hoped that psychology could become more scientific by studying behavior that could be observed unambiguously by the experimenter. This was called the Behaviorist movement. It became taboo to talk about mental events. All behavior had to be explained in terms of the stimulus and the response.*

*How can we approach the study of consciousness in a scientific manner? Consciousness takes many forms, but as I have already explained, for an initial scientific attack it usually pays to concentrate on the form that appears easiest to study. Christof Koch and I chose visual awareness rather than other forms of consciousness, such as pain or self-awareness, because humans are very visual animals and our visual input is especially vivid and rich in information. In addition, its input is often highly structured yet easy to control. For these reasons much experimental work has already been done on it.*

## STUDY 3

Neuroscience Condition (each participant read both passages)

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### Transcranial Magnetic Stimulation:

The brain machine that can read - and *write* - your mind.

by Julia Grant

In a concrete basement at the University of Sydney, I sat in a chair waiting to have my brain altered by an electromagnetic pulse. My forehead was connected, by a series of electrodes, to a machine that looked something like an old-fashioned beauty-salon hair dryer and was sunnily described to me as a "Danish-made transcranial magnetic stimulator." This was not just any old Danish-made transcranial magnetic stimulator, however; this was the Medtronic Mag Pro, and it is one of the most remarkable of the inventions that have repeatedly revolutionized the field of human cognition.

Transcranial Magnetic Stimulation (TMS), uses a focused magnetic pulse to randomize the neurons of a small part of the brain. Originally this was used to temporarily shut down specific parts of the brain, but scientists found that the ability to directly affect brain processes led to fascinating insights into the nature of human consciousness and decision making.

Years ago, American neuroscientist Benjamin Libet showed that before freely chosen movements, there is a distinctive build-up of electrical activity in the brain. And this build-up typically happens about half a second before you experience making a conscious decision to move your arm. So by the time you think, "OK, I'll move my arm," your body is already halfway there.

But the two neuroscientists hovering over me, to whom I have just signed over control of my brain, have taken Libet's discovery one remarkable step further. They found that, when asking people to choose to move either their left or right hands, it was possible, not just to predict, but to actually *influence* their choice by electronically stimulating certain parts of their brains. So, for example, the scientists could force the subjects to choose to move their left hands. But despite their choice being electronically directed, these patients continued to report that they were freely choosing which hand to move!

Thanks to modern neuro-imaging, we now know that our minds - our conscious, mental life - are a product of activity in the brain. What Libet's and subsequent experiments show is that even when we have the conscious experience of deciding, our brains - or state-of-the-art Danish-made contraptions - are the ultimate sources of our choices. As these mad Australian scientists fire up the machine on my head, I just wish my brain had decided not to sign that consent form.

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## Brain Scanners Can See Your Decisions Before You Make Them

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by David Rodrick

What do we really know about how we make decisions?

In a study published Sunday in *Nature Neuroscience*, researchers using brain scanners could predict people's decisions seven seconds before the test subjects were even aware of making them.

The decision studied -- whether to hit a button with one's left or right hand -- may not be representative of complicated choices that are more integrally tied to our sense of self-direction. Regardless, the findings raise profound questions about the way we understand brains and minds.

"Your decisions are strongly prepared by brain activity. By the time you become aware of what you want to do, your brain waves have often already given you away," said study co-author [John-Dylan Haynes](#), a Max Planck Institute neuroscientist.

Haynes updated a classic experiment by the late [Benjamin Libet](#), who showed that a brain region involved in coordinating motor activity typically became more active a fraction of a second before test subjects experienced choosing to push a button. Later studies supported Libet's theory that subconscious activity preceded and correlated with conscious choice -- but none found such a vast gap in time between brain activity and choice as Haynes' study has.

In the seven seconds before Haynes' test subjects chose to push a button, activity shifted in their frontopolar cortex, a brain region associated with high-level planning. Soon afterwards, activity moved to the parietal cortex, a region of sensory integration. Haynes' team monitored these shifting neural patterns using a functional MRI machine.

Taken together, the patterns consistently predicted whether test subjects eventually pushed a button with their left or right hand. The implications immediately seem far greater, and perhaps more unsettling, than learning about the physiological basis of other brain functions.

The unease people feel originates in a misconception of self as separate from the brain, said National Institutes of Health neuroscientist [Mark Hallett](#).

"That's the same notion as the mind being separate from the body -- and I don't think anyone really believes that," said Hallett. "A different way of thinking about it is that a lot more happens in your brain than you are conscious of."

In addition, some caveats remain. For instance, the experiment may not reflect the mental dynamics of other, more complicated decisions.

"Real-life decisions -- am I going to buy this house or that one, take this job or that -- aren't decisions that we can implement very well in our brain scanners," said Haynes.

Still, these types of findings -- more of which are appearing every year -- are forcing not only scientists, but also the general public to rethink the way they've always understood our minds to work

Haynes added, "when you start really probing the functions of the brain and consciousness, you realize that all of preconceptions about brains, minds, or even our selves, are no longer safe".

## Control Condition (each participant read both passages)

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### Do we need to go nuclear to stay green?

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by Julia Grant

It's the billion-dollar question. Will nuclear energy save the world from global warming? Nuclear power plants produce virtually zero carbon emissions throughout their lifecycle, but they are costly to build and environmentalists claim the money would be better spent on building renewable resources.

However, increased energy demands and rising fossil fuel prices may persuade governments to adopt nuclear energy anyway, according to a [new report published by the Nuclear Energy Agency](#) in France, which considered three scenarios.

Firstly, if renewable energy sources and carbon-capture technology proves to be highly successful, and public acceptance of nuclear energy is low, ageing reactors will be replaced with newer reactors of a slightly higher capacity, but no additional power stations would be built. Overall, the NEA estimates that nuclear installed capacity would increase to 580 gigawatts of electrical energy worldwide by 2050, compared to just 370 GW in 2007.

In the second scenario, renewable supplies don't meet their expected capacity, so our reliance on nuclear energy will need to be even higher. In this case, nuclear energy would provide 1400 GW of electrical in 2050 – roughly 12.5% of the predicted energy demand.

Finally, the authors considered whether governments could phase out nuclear energy, but they believe it "unlikely" that other sources could completely fulfill the increased demands.

#### 'White elephant'

Fabien Roques, an energy expert at Cambridge Energy Research Associates in Paris, France, believes the 1400-GW scenario is unrealistic given the slow pace of construction.

"Given the bottlenecks for major parts of nuclear plants it is unlikely that the pace of nuclear deployment could be realistically stretched beyond 680 GW in 2030," he says.

Environmental campaigners also say they are unconvinced by the report.

"Government plans to replace the current generation of nuclear plants are unlikely to deliver more than 10% of our energy needs," says energy campaigner Neil Crumpton from [Friends of the Earth](#), UK.

"Expansion beyond this would take decades," he says. "Urgent action is needed to cut emissions, but throwing more money at the nuclear white elephant is an expensive and dangerous distraction."

Elsewhere, further evidence could be seen today that more countries are now investigating whether to invest in nuclear power. Mohamed El Baradei, director general of the [International Atomic Energy Agency](#), today announced that "no fewer than 50 countries have informed the IAEA that they are considering introducing nuclear power", in a speech to mark the 50th anniversary of the NEA.

These countries include Turkey, Egypt, Vietnam and Nigeria. In addition, he points out that China will increase its nuclear capacity five-fold by 2020, and Russia plans to double its nuclear energy production in the same period.

## Tapping Nature's Headache Remedies

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Many of us may be too dependent on over-the-counter painkillers to treat the occasional headache, especially given the side effects of such drugs. Ibuprofen (Advil, Motrin) can increase the risk of heart and circulation problems—including heart attack and stroke—and is also tough on the digestive tract. Too much acetaminophen (Tylenol) has been linked to nausea, diarrhea, and kidney and liver problems. Many natural health care practitioners disparage drugs for merely masking the symptoms of larger problems.

All headaches are not the same and gobbling down pain pills will not address the causes, whatever they may be. Some headaches are caused by tension; others stem from sinus congestion, caffeine withdrawal, constipation, food allergies, spinal misalignment or lack of sleep. And then there are migraines, which researchers think are neurological in nature: The brain fails to constrict the nerve pathways that open the arteries to the brain, resulting in a pounding headache as blood flows in unchecked. Assessing what kind of headache you may have can help lead the way to a solution beyond deadening the pain with a pill.

To make tension headaches go away, the Farmers' Almanac recommends applying an ice pack to the neck and upper back, or, even better, getting someone to massage those areas. Also, soaking the feet in hot water can divert blood from your head to your feet, easing any kind of headache pain in the process.

Another all-natural headache cure is acupressure (like acupuncture, but without the needles), which promotes healing throughout the body by stimulating channels of energy known as meridians. Victoria Abreo, [alternative medicine](#) editor for the website BellaOnline, says that anyone suffering from a tension headache can employ a simple acupressure technique to help relieve the pain: "With one hand, press the shallow indentation in the back of the head at the base of the skull. Simultaneously, with the thumb and forefinger of the other hand, press firmly into the upper hollows of the eye sockets, right where they straddle the bridge of the nose and meet the 't' of the eyebrow bridge." She says to press softly at first, and then more firmly, holding for three to five minutes.

As for migraines, avoiding certain trigger foods might be key to staving them off. Abreo says migraine sufferers should try steering clear of dairy products, processed meat, red wine, caffeine and chocolate. New research has shown that some people with specific dietary deficiencies are more prone to migraines.

According to Dr. Linda White, who writes about natural health for Mother Earth News, some recent clinical trials have shown three nutritional supplements—magnesium, riboflavin and coenzyme Q10—to be particularly effective at reducing the frequency and severity of migraines. Also, a number of herbs—including feverfew, butterbur, lavender, ginkgo biloba, rosemary and chamomile—have proven track records in preventing or stopping migraines. Since herbs can be potent and are not regulated or tested, headache sufferers should consult a trusted doctor or naturopath before using alternative remedies.

### **Punishment scenario from Studies 2 & 3**

Please read the scenario and consider each question carefully:

*In the spring of 2005, Jonathan Scarrow, a high school senior in Ohio was involved in an altercation at a local bar which led to the death a college student, Brandon Mahew. Scarrow and his friends, most of whom attended a nearby college, were celebrating at a crowded bar after a local football game. Though Scarrow himself was not drinking, members of his group of friends found themselves in an alcohol-fueled fight with another group. While such scuffles were not uncommon, the consequences of this one – due to Scarrow’s involvement – proved fatal. While the other participants only dealt, at most, minor injuries, Scarrow entered an enraged state while fighting with Mahew. The other assailants were too distracted or disoriented to notice the level of Scarrow’s violence until it was too late. When Scarrow was finally subdued by his own friends, Mahew lay bloody and unconscious. He was rushed to hospital, but never regained consciousness, and finally died two days later from massive head trauma.*

*In the subsequent trial, the prosecution recommended life imprisonment, arguing that Scarrow had aggressive tendencies.*

*The defense lawyers responded with a proposal that Scarrow spend the initial part of his sentence at a new treatment facility that had proven essentially 100% successful at curing youths of their violent tendencies, regardless of the cause. Following the intensive treatment term, which would last two years, Scarrow would no longer pose a violent threat to society.*

*The defense team further reminded the court that, though incarceration of violent criminals deters other people from committing violent crimes, this deterrent effect does not depend on the length of the prison sentences given to violent criminals. Thus, time spent in the treatment facility would be sufficient for achieving the deterrent effect. The prosecution agreed on both counts, but maintained that, following the treatment, Scarrow should still serve prison time as an appropriate punishment for his crime.*



#### Abbreviated punishment scenario from Study 4

**Imagine that you are a juror asked to recommend a sentence for the following crime:**

*A bar fight breaks out at a college pub. One student (JS) ends up in an enraged state of violence that results in the death of another student. At the subsequent trial, the defense and prosecution agree that JS should enter a new type of treatment facility for 2 years, after which he will no longer pose a violent threat to society. Despite this, and despite the fact that both legal teams agree it would serve no effect in deterring future violent offenders, the prosecution argues that JS should still serve prison time in addition to the treatment time as an appropriate punishment for the crime.*

In a separate study to validate this scenario, participants' sentence recommendations were shown to be positively related to responses on a single item measuring retributive punishment ("Violent criminals deserve to suffer for their crimes"),  $r(238)=.28, p<.001$ , but unrelated to an item measuring consequentialist punishment ("The main goal of punishment should be to prevent future crimes"),  $r(238)=-.06, p=.33$ . These ratings provide convergent and divergent validity for the scenario as a measure of retributive punishment.

**Scales, Questionnaires and Suspicion Checks**  
**(where not previously described)**

**STUDY 1**

No validated scale exists for measuring **Retributive and Consequentialist Punishment attitudes**. As a result, participants were given the following description of the constructs:

*Philosophers discuss two primary motivations for punishment -- retributivism and consequentialism.*

*Retributivist motivations are those that seek to extract a punishment from a transgressor for the transgression they have committed. Underlying the retributivist motivation is the idea that transgressors deserve to suffer for the suffering they have caused to their victims and society.*

*Consequentialist motivations, on the other hand, are solely concerned with the social utility that punishment can produce--such as deterring others from committing future crimes, rehabilitation to ensure that transgressors do not repeat their transgressions, or incapacitation whereby the ability for the transgressor to commit another crime is removed (by locking them away, for instance). Whether or not the transgressors suffer as a result of these punishments does not matter to consequentialists.*

*Retributivism and consequentialism is not an either/or situation, as both motivations impact the American justice system.*

Participants were then asked the following questions, on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*):

*Please indicate how important you feel each motivation should be to criminal punishment:*

*(1) I feel that retributivism should be an important motivation in criminal punishment.*

*(2) I feel that consequentialism should be an important motivation in criminal punishment.*

**Education** was assessed on a 9-point scale from 1 (completed some high school) to 9 (completed graduate or professional degree).

**Religiousness** was assessed on a 5-point scale measuring frequency of religious attendance from 1 (never) to 5 (one or more times a week).

**Political orientation** was assessed with three items, each rated on a 7-point scale from 1 (very liberal) to 7 (very conservative),

What is your **general** political orientation?

In terms of **social** issues, do you consider yourself:

In terms of **economic** issues, do you consider yourself:

### ***STUDY 2 and 3***

**Suspicion Check:** Participants were asked to speculate in open-ended responses “what you thought was the research question of interest for each of the studies you completed,” and to indicate whether they thought the three purportedly separate tasks were related on a 1 (not at all) to 5 (completely) scale. Participants who answered >3 on the scale, and accurately guessed the research aim of the manipulation and punishment components of the study were eliminated from analysis (0 in Study 2, and 3 in Study 3).

### ***STUDY 3***

**Mood** was measured using the Positive And Negative Affect Scale, a widely used scale asking participants how they feel right now on several indicators of positive (*Interested, Proud*) and negative affect. Each item is rated from 1 (*Very slightly or not at all*) to 5 (*Extremely*).

### ***STUDY 4***

**Self-reported relative knowledge of the brain** was measured with a single item: “Compared to the average student [at this university] how informed would you say you are about the human brain? (check one box)” rated from 1 (*Know much less than average*) to 7 (*Know a lot more than average*).

**Class Standing** was measured with a single item: “As a rough estimate, where do you think you fell in terms of the distribution of grades in this class” rated from 1 (*Bottom fifth*) to 5 (*Top fifth*). Indicating a strongly optimistic self-enhancement effect, no student predicted they fell below the middle quintile.