

# Researchers gain new insight into self-control using neuroimaging

September 4 2017

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Credit: Arizona State University

Grocery shopping while hungry is a bad idea, often leading to regrettable surrender to momentary cravings. Yet we fall victim to this pitfall time and again, despite our rational mind knowing better.

ASU Associate Professor of psychology Samuel McClure and researcher Ian Ballard wanted to know why. Their paper, "More is meaningful: The magnitude effect in intertemporal choice depends on self-control," published today in the journal *Psychological Science*, may provide some answers. In it, the duo detail how they were able to use neuroimaging to show that self-control varies depending on how important a decision is, and that it can be augmented when people are asked to justify their decision.

"I think it's exciting because once you have a handle on the neuro systems, once you have a way of measuring them, you can start really asking interesting questions," McClure said. Superior to [behavioral experiments](#), brain imaging allows scientists to "track [a person's actions] down to the particular neuro systems and start thinking about why they function that way."

Scientists have long agreed that self-control is just another example of executive functions, a set of mental skills that help us do things like set goals, manage time and pay attention. They are controlled by an area of the brain called the frontal lobe.

But trying to understand more about factors that might influence behaviors thought to be controlled by executive function—such as self-control—has been extremely difficult because the only way to do so was through behavioral experiments that required outside manipulation of executive functions, making it hard to separate the effects of manipulative factors from the effects of a person's behavioral change.

For example, if a researcher wanted to know how anger affects a person's ability to drive, they might play loud music to manipulate the person into becoming angry. However, though [loud music](#) might indeed make someone angry, it could be their inability to focus because of the music rather than their state of anger induced by the music that affects

their ability to drive.

"That's where neuroimaging comes in," McClure said. "Because if you can isolate some set of behaviors that are related to self-control, then you can see which brain areas correspond to those behaviors. Then you don't have to manipulate behavior, you can just measure it to see how those brain areas are related to self-control processes."

So for his and Ballard's study, they first asked a group of subjects to make a choice between a small amount of money now or a large amount of money later. They found that not only did the pre-frontal cortex area of the subjects' brains—the area thought to be responsible for engaging self-control—show heightened activity when making the decision, but that the activity was even greater when the option of a larger reward was introduced, a phenomenon known as the magnitude effect.

They then repeated the experiment but followed it by asking the participants to rate their level of hunger, and found that hunger significantly affected whether they were willing to wait until later for a larger reward or take a smaller reward now, with those who reported being hungrier more likely to take the smaller reward now.



Researcher Ian Ballard (left) and ASU Associate Professor of psychology Samuel McClure were able to use neuroimaging for the first time ever to show that self-control varies depending on how important a decision is, and that it can be augmented when people are asked to justify their decision. Credit: Deanna Dent/ASU Now

Finally, they asked participants to imagine a scenario in which they won money in a raffle. They could either take the money right away or wait a month for a larger sum. Before they made their choice, they were told they had to justify it with an explanation. They found that when participants were asked to justify their choice, they displayed significantly more patience, preferring to wait for the larger sum of money.

McClure and Ballard said the results of the study have implications for broad societal issues, such as obesity and addiction.

"A lot of these things are self-control problems," McClure said. "We don't really understand how it is that the environment shapes how much control you have—although I think people who own restaurants and convenience stores know very well the opposite of that.

"So from a basic science standpoint, there's a lot of interest in economics about how should we structure the environment to help people make the choices they really want to make?"

That could mean adding more bike lanes on city streets to encourage people to exercise or adding calorie information to menus, something the FDA required all restaurants with 20 or more locations to do beginning in May.

It could also help to change the way you look at information, Ballard said. In particular, the magnitude effect, wherein people respond more to larger numbers, comes into play.

"If you're trying to lose weight, it's kind of disappointing when you only lose half a pound in two weeks," he said. "But if you set a goal to lose 500 grams a week, you feel more accomplished."

The seemingly larger number—500 grams, as opposed to 1 pound—is more likely to stimulate [self-control](#) in relation to a diet or exercise regimen, according to the researchers. Simply looking at the information differently can lead to a different outcome.

McClure and Ballard also recently received funding to conduct research on ADHD using the same theories and neuroimaging methods. They hope their work will eventually lead to interventions for such disorders,

as well as insights into how to habitize good behaviors, such as running every morning.

"One thing that's really exciting about cognitive neuroscience," McClure said, "is that it allows you to get at some of the basic mechanisms that control brain function and are linked to interesting and important behaviors ... and I think we've identified some critical levers that you can manipulate to help people out."

**More information:** Ian C. Ballard et al. More Is Meaningful: The Magnitude Effect in Intertemporal Choice Depends on Self-Control, *Psychological Science* (2017). [DOI: 10.1177/0956797617711455](https://doi.org/10.1177/0956797617711455)

Provided by Arizona State University

Citation: Researchers gain new insight into self-control using neuroimaging (2017, September 4) retrieved 5 May 2024 from

<https://medicalxpress.com/news/2017-09-gain-insight-self-control-neuroimaging.html>

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