Contrary to Popular Models, Sugar Is Not Burned by Self-Control Tasks (w/ Video)

June 10 2010

(PhysOrg.com) -- Contradicting a popular model of self-control, a University of Pennsylvania psychologist says the data from a 2007 study argues against the idea that glucose is the resource used to manage self control and that humans rely on this energy source for will power.

The analysis, conducted by Robert Kurzban and published in the current issue of the journal Evolutionary Psychology, shows that evidence previously presented in favor of the claim that the brain consumes extra glucose when people exert self-control shows no such thing.

The new analysis contradicts results published in the Journal of Personality and Social Psychology based on "resource" models of self control, suggesting that when people exert self control -- by, for example, carefully focusing their attention -- a resource is "depleted," leaving less of it for subsequent acts of self control. This study identified glucose as this resource that gets depleted.

"For this model to be correct, it obviously must be the case that performing a self-control task reduces glucose levels relative to pre-task levels," Kurzban said. "Evidence from neurophysiology research suggests that this is unlikely, and the evidence for it is mixed at best."

By analyzing the portion of the data made available by prior researchers, Kurzban discovered that, in the studies reported, glucose levels did not decrease among subjects who had performed self-control tasks. In short, his reanalysis shows that the researchers' own data undermine the model they advance in their paper.

Kurzban's new analysis is consistent with the neuroscience literature, which strongly implies that the marginal difference in glucose consumption by the brain from five minutes of performing a "self-control" task is unlikely in the extreme to be of any significant size. Further, research on exercise shows that burning calories through physical activity, which really does consume substantial amounts of glucose, in fact shows the reverse pattern from what the model would predict: People who have recently exercised and burned glucose are better, not worse, on the sorts of tasks used in the self-control literature.

"The failure to find the effect predicted by the glucose model of self control is not surprising given what is known about brain metabolism," Kurzban said. "Even very different computational tasks result in very similar glucose consumption by the brain, which tends to metabolize glucose at similar rates independent of task."

Furthermore, even if exerting self control did reduce levels of glucose, the cause of the reduction could be factors such as increased heart rate when people perform certain kinds of tasks, rather than consumption by the brain. Glucose levels are probably influenced, Kurzban said, by a cascade of physical and psychological mechanisms that mediate glucose levels throughout the body.

“The weight of evidence implies that the glucose model of self control in particular -- and perhaps the resource model in general -- ought to be carefully rethought,” he said. “From a computational perspective, a ‘resource’ account is the wrong kind of explanation for performance decrements to begin with. No one whose computer is performing slowly would think that the fault lies in not having sufficient electricity -- or that running Excel for five minutes will drain the battery and so make Word slow down -- even though no one would deny that electricity is necessary for computers.”

One way to put the prior data in context, according to Kurzban, is to consider the data in terms of the familiar unit of calories. The brain as a whole consumes about one quarter of one calorie per minute. Obviously, the consumption rate for just the fraction of the brain involved in “self control” must, logically, be much smaller than .25 calories per minute. A 1 percent increase across the entire brain would, over the course of a five-minute task, consume .0125 calories. If one assumes an order of magnitude greater effect, a 10-percent increase, the amount of energy consumed would still be much less than a single calorie.

“Even with these extreme assumptions, potentially off by orders of magnitude, the caloric cost would still be well less than .2 calories,” Kurzban said. “The brains of subjects categorized as ‘depleted’ in this literature, have, relative to controls, used an additional amount of glucose equal to about 10 percent of a single Tic Tac."

Provided by University of Pennsylvania