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Size of food packaging and cognitive performance

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Many factors have been shown to affect individuals' cognitive performance, such as sleepiness, hunger, motivation, etc. One such factor that has recently gained much attention is self-regulation, or one's ability to control, regulate, or change his or her behaviors. In lay terms, self-regulation may be thought of more or less as self-control.

Research has indicated that self-regulation functions in a way similar to a muscle, in that it gets "tired" after repeated use. Muraven and Baumeister (2000) found that, after participants utilized self-control, they were more likely to fail in subsequent attempts at self-control. In experiments done by Vohs and Heatherton (2000), dieters who resisted good-tasting food once were less likely to subsequently resist it. Additionally, dieters who resisted good-tasting food showed less persistence on an unsolvable task, and dieters asked to inhibit their facial expressions and emotional reactions during a sad movie clip ate more ice cream than those allowed to be expressive (Vohs & Heatherton, 2000). This research therefore reveals a key finding that self-regulation is not domain-specific (i.e. resisting food not only leads to less successfully resisting it again later, but also to poorer performance on a cognitive task). This means that self-regulation depletion in one domain affects self-control in other domains.

Gailliot, Baumeister, DeWall, Maner, Plant, Tice, Brewer, & Schmeichel (2007) also conducted studies supporting the construal of self-regulation as a muscle: they found that acts of self-control reduced blood glucose levels. They also found that low levels of blood glucose obtained after completing a self-control task were associated with worse performance on a self-control task done later, and that primary acts of self-control hindered performance on self-control tasks done later (Gailliot et al., 2007). However,

drinking a glucose drink eradicated these negative effects and restored participants' performances to pre-self-control task levels (Gailliot et al., 2007). This research suggests that glucose provides a limited source of energy for the exertion of self-control or self-regulation.

Together, this research on self-regulation suggests that it is a limited resource, which, when depleted in one area, reduces self-regulation ability across other areas. Many past studies regarding self-regulation have incorporated food as a way to deplete self-regulation. In particular, the size of food packaging may be a way to manipulate self-regulation depletion.

Research indicates that people are driven to eat more food if it is presented in a smaller package as opposed to a larger package. This research has been replicated in animals as well – mice ate 20% more food when it was presented in large-sized food pellets as opposed to smaller ones (Balagura & Harrell, 1974). Another study found that when snack foods were left out to eat in either small or large forms (i.e. large sized Tootsie rolls vs. small sized Tootsie rolls), more food was consumed when the food was in its larger form (Geier, Rozin, & Doros). Even when given unpalatable popcorn rated by participants as tasting bad, people still ate more when it was in a larger container as opposed to a smaller one (Wansink and Kim, 2005).

The current study ties together these past findings on self-regulation and food consumption as it relates to size of packaging. Because people are inclined to eat more food when it is presented in a large package, it should take more self-regulatory resources to resist food in a large package (versus a small package). Therefore, it was hypothesized that participants given a large package of food would show poorer performance on a

concurrent cognitive task (the Stroop task) than participants given a small package of food, as measured by the latency and accuracy of responses. Specifically, it was hypothesized that participants given a large package of food would perform more slowly and less accurately on the Stroop task.

Methods

Participants

Participants in the study were 22 Introduction to Psychology students at University of Richmond, participating in exchange for course credit.

Procedure

After signing consent forms, participants were seated at a computer in a laboratory room and given their choice of food (they could choose between potato chips or M&Ms) in either small or large packages. There were 11 participants who received food in a large package and 11 participants who received food in small packages. In the large package condition, a single large package of food was opened and placed within reach of the participant. In the small package condition, a single small package of food was opened and placed within reach of the participant, but there was also a pile of unopened small packages within reach, creating a total amount of food comparable in quantity to the amount in the single large package. Participants were told that they were free to eat the food in front of them, but in order to create restraint, they were told that another group of participants was coming after them so they needed to save some food for those individuals.

After instructions were given, participants began the Stroop task on the computer. In this task, participants aimed to identify the font color of each word displayed on the

screen by pressing a corresponding key on the keyboard ("r" for red, "b" for blue, etc). Words that named colors were displayed in colored fonts, sometimes differing from the color named (i.e. "yellow" printed in red font). The task was structured in a format that gave about 4 minutes of the Stroop task followed by a 2 minute break. This cycle repeated for about 25 minutes. Participants were only allowed to eat during the 2-minute breaks spread throughout the task, and not during the actual Stroop task itself.

After completion of the Stroop task, participants were asked to fill out a questionnaire measuring their attitudes towards the task and towards food. The questionnaire garnered other information, such as the time elapsed since the participant last ate, his or her perceived number of calories eaten during the experiment, whether or not his or her eating was restrained during the experiment, etc. Each participant's food was weighed before and after the experiment to assess the amount of food eaten.

After the experiment, participants were debriefed and given a handout containing information and resources regarding eating disorders, due to the fact that the questionnaire touched on sensitive topics concerning food and participants' attitudes towards food.

Results

A main Stroop effect was found for both latency and accuracy, meaning that all participants (despite the size of food packaging) performed faster on the Stroop task when the font color and word name were congruent ($M = 624.90$ milliseconds) rather than incongruent ($M = 769.60$ milliseconds), and they performed more accurately on the Stroop task when the font color and word name were congruent ($M = 98.36$ percent correct) rather than incongruent ($M = 93.85$ percent correct).

Independent-samples t-tests were run to test the hypothesis. It was found that, contrary to the hypothesis, the Stroop task reaction time of participants in the large package condition (M = 686.76 ms, SD = 76.44) was not significantly slower than the reaction time of participants in the small package condition (M = 702.70 ms, SD = 88.13), t(20) = -0.45, *ns*. Nor was the Stroop task accuracy of the participants in the large package condition (M = 96.09 percent, SD = 3.49) significantly worse than the accuracy of the participants in the small package condition (M = 96.11 percent, SD = 3.08), t(20) = -0.15, *ns*.

Although the hypothesis was not supported by the data, further data analyses showed interesting findings. Participants in the large package condition perceived that they ate significantly fewer calories (M = 51.36 calories, SD = 28.29) than participants in the small package condition (M = 145.50 calories, SD = 83.68), t(19) = -3.52, $p < .05$. However, the actual number of calories eaten did not significantly differ between the large package group (M = 104.59 calories, SD = 83.86) and the small package group (M = 149.98, SD = 54.53), t(20) = -1.51, *ns*.

Discussion

The results did not support the hypothesis, and instead indicated that neither the reaction time in milliseconds, nor the accuracy measured by number of correct responses significantly differed between participants who received food in a large package versus a small package. These results suggest that there was no difference in self-regulation depletion between the two groups.

However, it was found that participants with food in a large package thought they ate fewer calories than participants with food in a small package, even though the actual

number of calories eaten did not differ between the groups. These findings can be related to findings of Wansink and Kim (2005), who noted that the environmental cue of having a larger package makes eating a larger amount "normal" or "appropriate." Because participants with food in a large package are eating a relatively small proportion of what is available, their idea of an "appropriate" amount to eat likely becomes bigger and they underestimate the amount of calories eaten. Participants with a small package of food already have their portions rationed, creating a much smaller idea of an "appropriate" amount to eat; thus they are less likely to underestimate the amount of calories eaten.

There were several important limitations to the current study. Although participant assignment to each group aimed to be random, there ended up being an important difference between the groups. Participants who were scheduled to run at the same time slot were all assigned to the same group (large or small package) in order to keep things consistent and avoid suspicion or confusion among participants. Perhaps due to the fact that participants scheduled to run at the same time of day were all assigned to the same group (small or large packaging), the results could have been affected in regards to the hunger level of the subjects. In fact, it was found that participants in the small package condition had gone significantly longer without eating ($M = 216.67$ minutes, $SD = 81.20$) than participants in the large package condition ($M = 128.64$ minutes, $SD = 70.32$), $t(18) = -2.60$, $p < .05$. This difference in the time elapsed since participants last ate likely signifies a higher level of hunger in the participants in the small package condition, which could lead to more distraction and poorer Stroop performance for these individuals (which would help explain why the hypothesis was not supported).

Another limitation was that participants were run with other participants at same time – they were usually run in groups of three. This could create self-consciousness for some participants, or could lead participants to eat a certain amount based on how much other participants eat.

An additional limitation was that the restraint mechanism used in the study was weak. Previous studies in this area have already had built-in restraint because they are run using dieters as participants; however, the University of Richmond Introductory to Psychology students do not fall into this type of narrow population, so restraint had to be induced by other means. This study attempted to induce restraint by telling participants to leave food for more participants coming later, but this attempt did not work well – only 7 participants claimed in the questionnaire that they "tried not to eat too much," whereas 14 participants said they "ate as much as they wanted." In order for the experiment to work, restraint is necessary (to deplete self-regulation). Therefore, the failure to fully induce restraint among participants was a crucial limitation to the study.

An additional limitation was that the number of participants was low, at only 22 (11 to each condition).

In future research, it would be beneficial to correct the aforementioned limitations, making improvements such as randomly assigning participants to each group, running participants individually, creating a new restraint mechanism, and having all participants fast for a couple hours before the experiment in order to start them out on approximately the same level of hunger.

It is important to understand when and why people fail at self-regulation, so that we can improve it and create healthy changes to help us fit with our surroundings and

avoid impairing our cognitive performance. This study has implications for people who have certain issues with food (obese people, dieters, etc), or simply anyone trying to be healthier.

For example, this study suggests that it would be wise to serve healthy foods in large portions and unhealthy foods in small portions, in order to eat more healthy food and less unhealthy food, and also to keep from underestimating the amount of calories of unhealthy foods eaten.

If the hypothesis were supported, as it likely would be if the limitations were addressed, the experiment could have many other implications – for example, it could create awareness that trying to resist food will take a toll on one's self-regulatory ability not just for food but across many domains – for this reason, it would be easier to buy and eat food in smaller portioned packages to avoid depleting one's self-regulatory resources, needed for many other functions.

Self-regulation depletion is an important and relevant topic deserving of future research. In particular, continuing to explore the way that presentation of food affects self-regulation could have useful applications in the everyday lives of Americans.

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