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Memory and Decision Processes: The Impact of Cognitive Loads on Decision Regret

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Abstract

Every day, people both make decisions and regret decisions. Whether it is second-guessing a major life choice like one's career or bemoaning the purchase of a particular shirt, the phenomenon of regret is familiar and tangible. It is important to learn more about this psychological occurrence in order to help people avoid regret by making better decisions in the future (Das & Kerr, 2010; Pieters & Zeelenberg, 2007). Learning about regret necessitates both learning how the inherent mechanism of regret works, and also what external circumstances affect the degree of the regret. Does being distracted on a cell phone while shopping at the grocery store make you more or less regretful? Can other disturbances actually help you make more satisfactory decisions? We hypothesize that the less attention an individual dedicates to a decision, the less regret he or she will experience.

In this research paper we will explore the intersection of two large bodies of research on the topics of cognitive load theory and decision regret and investigate whether individuals subject to a cognitive load during a decision will subsequently experience more or less decision regret. Before discussing our experiment, though, we will conduct an in-depth research analysis on each of these topics. This literature review will include a general introduction to cognitive load theory and regret, various frameworks through which to understand both topics, and some practical applications and implications for each body of research. We will then synthesize the information and construct the hypothesis that an individual under a cognitive load will experience less regret than an unrestrained individual. Following that, we will go through the mechanics of the experiment and present the results of the data obtained. Lastly, we will discuss the results and develop some conclusions.

Keywords

cognitive load, memory, decision regret

Disciplines

Business | Cognition and Perception | Psychology | Social and Behavioral Sciences

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Introduction:[1]

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In this research paper we will explore the intersection of two large bodies of research on the topics of cognitive load theory and decision regret and investigate whether individuals subject to a cognitive load during a decision will subsequently experience more or less decision regret. Before discussing our experiment, though, we will conduct an in-depth research analysis on each of these topics. This literature review will include a general introduction to cognitive load theory and regret, various frameworks through which to understand both topics, and some practical applications and implications for each body of research. We will then synthesize the information and construct the hypothesis that an individual under a cognitive load will experience less regret than an unrestrained individual. Following that, we will go through the

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mechanics of the experiment and present the results of the data obtained. Lastly, we will discuss the results and develop some conclusions.

Cognitive Load:

The first dimension of this study is based on existing literature discussing the various memory processes. There are three main stages of memory: the sensory memory, the working memory, and the long-term memory. Broadly speaking, the sensory memory deals with short-lived incoming sensory inputs and the long-term memory holds dormant information for long periods of time (Schachter & Tulving, 1994). The working memory, which is the middle step in the process, is defined as "a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning" (Baddeley, Logie, Bressi, Sala, & Spinnler, 1986). The working memory functions as a medium through which the sensory interactions with our surroundings are eventually encoded as long-term memories. Information must be processed through the bottleneck working memory.

The working memory has limited bandwidth with which to process information. Data processed in the working memory can be lost in less than 20 seconds (Peterson & Peterson, 1959). Certain types of rehearsal can keep information in the working memory for longer than the 20 seconds and correlate to better long-term recall (Craik & Watkins, 1973), yet this exercise of the working memory requires effort that can come at the expense of other tasks (Salvucci & Beltowska, 2008). The scope of the working memory can also be extended using various sensory channels; Baddeley discusses how directing information through both visual and auditory stimuli can increase the total capacity of the working memory (Baddeley et al., 1986). In the field of

education, for example, teachers who want to increase their students' retention should use various different modes of communication during instruction.

The reason students can struggle with processing information is because, as mentioned before, the working memory has a limited capacity. The amount of information that can be held in the working memory has been debated for decades. Groundbreaking research published in the book *The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information* by George Miller argued that the average individual can remember approximately seven pieces of information, give or take two pieces (Miller, 1956). This result is also referred to as Miller's law. He also famously noted that information is stored in chunks: hence the ability to remember seven words instead of just seven letters. The brain is able to use this chunking heuristic to remember more bits of information.

Ensuing research challenged Miller's conception of the average size of an individual's working memory. In 1974, Simon published an article claiming that the capacity of the human working memory is actually five to seven pieces of information (Simon, 1974), while Broadbent later argued that the capacity is only three chunks of information (Broadbent, 1975). Bettman and Hayes both asserted that one can process about six chunks (Bettman, 1979; Hayes, 1962) while Streufert mentions that the mind can retain ten separate chunks of information (Streufert, Suedfeld, & Driver, 1965). Malhotra analyzes the capacity by looking at how many disparate pieces of information can be processed at the same time, and determines that an average working memory can support forty five total comparisons across choices (Malhotra, 2014).

The discussions between these academics all operate within the vacuum of an unoccupied memory; they discuss how much potential internal capacity exists within the working memory. However, there are an unlimited number of distractions that can inhibit the potential capacity of

the mind. Listening to music has been shown by Salamé to place a strain on the working memory (Salamé & Baddeley, 1989), while Luethi discusses how external stress can also limit the working memory capacity (Luethi, Meier, & Sandi, 2008). Sleep deprivation also has been shown to impede working memory processing capacity (Chee & Choo, 2004; Mu et al., 2005).

Cognitive load theory emerged from the conception that it would be possible to positively affect people's information processing capacities by consciously studying and manipulating external circumstances and variables. By extension, cognitive loads can also impact people's capacities to learn and make decisions. There are two main types of cognitive loads: intrinsic loads, which are triggered by the nature of the task itself, and extraneous loads, which are caused by the instruction design (Schnotz & Kürschner, 2007). For example, an intrinsic load would be the complexity of a math question on an exam while the extraneous load would be the clarity of the question instructions. Before the 1990s, cognitive load theory "almost exclusively focused on instructional designs" in the education field (Schnotz & Kürschner, 2007, page 472), but more recently it has been applied to a broader range of fields.

Given the foundations of cognitive load theory explained above, the question remains regarding what precisely is the mechanism that makes cognitive loads work. There are many lenses through which to approach this topic, and we will briefly discuss how cognitive loads manifest in various decision strategies and in affect versus cognition.

Decision strategies can be divided into two main categories: similarity-based strategies and rule-based strategies (Erickson & Kruschke, 1998; Juslin, Karlsson, & Olsson, 2008; von Helversen & Rieskamp, 2008). Similarity-based strategies superficially analyze a decision to fit it into an existing decision model, while rule-based strategies abstract a rule to make an informed, specific decision. Similarity-based strategies therefore draw on existing decision

frameworks, while rule-based strategies attempt to create a new particular framework. People tend to switch between these two frameworks depending on the situation (Juslin et al., 2008; von Helversen, Mata, & Olsson, 2010).

In the local subject of cognitive loads, Hoffman, von Helversen and Rieskamp describe that individuals under a cognitive load were more likely to switch to use a similarity-based strategy while individuals not under a cognitive load would dedicate more working memory to a rule-based strategy (Hoffmann, von Helversen, & Rieskamp, 2013). Their experiments show that cognitive loads made subjects less effective at tasks well-suited for rule-based strategies while cognitive loads were helpful in situations well-suited for similarity-based strategies. These results are corroborated by other research showing that decision strategies that require a high amount of working memory are less effective, and even impaired, while under a cognitive load (Beilock & Decaro, 2007; J. W. Payne, Bettman, & Johnson, n.d.; Rieskamp & Hoffrage, 2008). Thus, one mechanism through which cognitive loads have an effect is by crafting the decision strategy an individual uses in a given task.

Another framework useful in analyzing how cognitive loads work is affect and cognition during decision making. There are two large categories of decision processes of low-order affect and higher-order cognition. A similar dichotomy of two parallel systems of decision strategies with a rapid experiential process or a rational deliberate system is highlighted in Epstein's Cognitive-Experiential Self-Theory (Epstein, 1993). Zajonc proposes that affect can circumvent cognitive processes to make quick decisions (Zajonc, 1980) while Hoch and Loewenstein discuss how impulses and desires can cause consumers to make purchase decisions mindlessly without rational deliberation (Hoch & Loewenstein, 1991).

Shiv and Fedorikhin researched the prevalence of these two main strategies under various degrees of cognitive load (Shiv & Fedorikhin, 2014). They describe how automatic-affective processes are relied upon when under a cognitive load, while deliberate cognitive processes are relied upon when not under a cognitive load. Their experiment highlights this concept very clearly. First, they randomly assigned participants to either be subject to a cognitive load or not. After this random assignment, the participants were presented with both chocolate cake and fruit salad. The subjects not under a cognitive load relied on their deliberate cognitive processes and rationally decided to consumer the healthier fruit salad, while the subjects under a cognitive load relied more on their automatic-affective processes and decided to eat the ostensibly less healthy chocolate cake. Shiv and Fedorikhin frame this discussion as a struggle between the mind and the heart; given an appropriate amount of cognitive bandwidth, people can make positive rational decisions and not succumb to the temptations of the heart (or stomach).

Whether it works through the mechanism of shifting decision strategies from rule-based to similarity-based or by causing more affective decisions instead of cognitive decisions, cognitive loads have a wide-reaching effect on people's actions. There are many situations in which cognitive loads seem to have a negative impact. Intuitively, Baddeley and Hitch discuss how cognitive loads severely impair the ability of one's memory to recall information (Baddeley & Hitch, 1974). As mentioned above, Shiv and Fedorikhin also showed that cognitive loads can cause individuals to make impulse purchases that the individual rationally should not purchase (Shiv & Fedorikhin, 2014).

Additionally, cognitive loads can have a deleterious impact on one's ability to lie convincingly. Vrij discusses how the action of lying requires more working memory capacity than telling the truth because lying requires one to formulate the lie, actively control one's own

body language to seem innocent, monitor the other party's body language, and suppress the truth (Vrij et al., 2008). It is thus more cognitively demanding, and Vrij's experiments show that people struggle to lie convincingly while under a cognitive load. Yogev-Seligmann shows that distractions that form a cognitive load can have negative effects on one's motor abilities (Yogev-Seligmann, Hausdorff, & Giladi, 2008) and Logie discusses how high cognitive loads can restrict one's ability to solve arithmetic math problems (Logie, Gilhooly, & Wynn, 1994). These situations all are suited for rule-based decision strategies and deliberate, cognitive processes.

However, situations exist in which deliberation can be destructive, and operating under a cognitive load can actually improve one's effectiveness at a task. Beilock observed individuals playing golf, and found that while the players' performance improved while they under a cognitive load (Beilock, Carr, MacMahon, & Starkes, 2002). The players benefited from using a similarity-based strategy; by trusting their instincts, they were able to subconsciously use their muscle memory to improve their scores. Similarly, Beilock and Decaro constructed math questions for which answers were based on simple-strategies, and found that subjects identified the simple-strategy solutions more frequently while under a cognitive load (Beilock & Decaro, 2007).

Individuals may also reap benefits from cognitive loads during emotionally-laced decisions (Drolet & Luce, 2004). In emotional decisions, people are often forced to make tradeoffs on values while making a choice, and use heuristics in order to simplify the decision (Luce, Bettman, & Payne, 1997). A frequent heuristic is to avoid the choice with the less important personal value, despite the fact that it is overall a better choice. An example of this is when buying a car. Individuals may purchase a car with good safety ratings even while all of the other product attributes (gas mileage, sticker price etc) are poor. Once a cognitive load is

introduced, though, individuals tend to "fail to appreciate the implications of ego-relevant behaviors by diverting their attention away from self-goals" (Drolet & Luce, 2004, pages 63-64). Consumers under a cognitive load will not fall prey to these avoidance behaviors surrounding emotional decisions, and will actually be able to make a more rational decision.

Given these examples of cognitive loads impacting decisions or behaviors, how does being subject to a cognitive load impact someone's level of decision regret? Is a rule-based strategy or a similarity-based strategy optimal for situations primed for regret? Similarly, is affect preferable to cognition in regret-prone decisions? In order to build a hypothesis surrounding these questions, it is first necessary to better understand the phenomenon of regret.

Decision Regret:

A common trope in modern society equates freedom and happiness. Equal and unlimited opportunity is a central part of our culture, and the ability to make impactful decisions is viewed as a foundation of democracy. More concretely, though, there is also scientific evidence that shows choice is correlated with increases in intrinsic motivation, life satisfaction, perceived control and task performance (Langer & Rodin, 1976; Rotter, 1966; Ryan & Deci, 2000; Schulz & Hanusa, 1978; Taylor & Brown, 1988). However, this mantra of more choice paralleling more happiness recently has been disputed anecdotally and scientifically to show that more choice actually reduces happiness and increases regret (Iyengar & Lepper, 2000).

Decision regret has a number of potential benefits. In a broad evolutionary sense, regret serves as a helpful trigger to alert individuals when they have made a poor choice, and thus helps them refrain from making a similar mistake in the future (Zeelenberg, 1999). Regret can thus help project people on positive trajectories for growth and success by preventing future errors.

Regret has also been found to improve assessments of post-choice valuation (Inman, Dyer, & Jia, 2014) and to have an inverse relationship with repurchase intent (Tsiros & Mittal, 2000). Patrick, Lancellotti & Hagtvedt, notably, show that regret of an inaction can actually serve to increase repurchase intent, furthering the conception that regret can function as a corrective motivator (Patrick, Lancellotti, & Hagtvedt, 2009). The psychological phenomenon of regret works to retroactively clarify actions and prompt self-reflection to promote more successful future decisions. Understanding precisely why and in what situations people experience regret will help people channel their regret into more productive future actions (Pieters & Zeelenberg, 2007).

There are two main actions that lead to regret: acts of omission and acts of commission. Research by Gilovich asked individuals the question "When you look back on your life to this point, what are your biggest regrets?" Regrettable failures to act constituted 63% of the regrets mentioned (Gilovich & Medvec, 1995). These acts of omission included familiar regrets of "missed educational opportunities," "missed romantic opportunities," and "not spending enough time with relatives." Foregone opportunities remain salient in the mind of individuals, prompting them to take advantage of future situations to spend time with their family or seize career opportunities.

On the other hand, acts of commission can also yield considerable regret. Kahneman and Twersky (Kahneman & Twersky, 1982) asked subjects to respond to the following prompt:

> "Mr. Paul owns shares in company A. During the past year he considered switching to stock in company B, but he decided against it. He now finds out that he would have been better off by $1,200 if he had switched to the stock of company B. Mr. George owned shares in company B. During the past year he switched to stock in company A. He now

finds that he would have been better off by $1,200 if he had kept his stock in company B. Who feels greater regret?"

Predictably, 92% of respondents said that Mr. George is more regretful because he actively sold the shares in company B whereas Mr. Paul simply did not buy them. Other examples of acts of commission found by Gilovich (Gilovich & Medvec, 1995) include "I shouldn't have smoked," "I shouldn't have married so early," and "I shouldn't have stressed work so much." Both of these types of regret are causing the introspection and self-reflection mentioned by Zeelenberg above.

On a smaller scale, individuals and consumers also experience regret. Iyengar and Lepper conducted studies testing for regret in less consequential decisions like tasting chocolate or purchasing jam at a grocery store (Iyengar & Lepper, 2000). In these situations, they found that consumers experience decision regret as well as decision paralysis, when the information overload between choices actually renders an individual unable to make a decision.

Various academics discuss different psychological stimulants of regret. One strand of researchers, including Bell and Loomes & Sugden, maintains that regret is driven by counterfactual thinking (Bell, 1982; Loomes & Sugden, 1982). After a decision, an individual envisions all of the other options and says to him or herself that "I should have chosen the other, better option." Personal accountability also plays a role in causing regret (Schwartz, 2004; Schwartz et al., 2002). Upon making a poor decision, individuals internalize the blame of the mistake and say "it was my fault that I made a bad decision." By being involved in the decision process and appreciating the bad outcome of the process, individuals experience regret for their personal actions. Das and Kerr point out that both of these factors play a role in creating the regret, and discuss how analyzing the source of the regret can help individuals avoid experiencing it (Das & Kerr, 2010).

The existence of regret substantiates other psychological frameworks as well. Kahneman and Miller describe how regret is a result of expectancy disconfirmation, and they note that negative disconfirmation elicits a stronger emotional response than positive disconfirmation (Kahneman, Miller, Griffin, Mcpherson, & Read, 1986). Additionally, Oliver shows that cognitive dissonance plays a role in amplifying regret (Oliver, 1997).

There are many extra-decisional factors that can affect the magnitude of decision regret. Barry Schwartz famously categorizes individuals into two types of buckets: maximizers and satisficers. According to Schwartz, maximizers are people that are focused on experiences or decisions always resulting in the absolute best outcome, whereas satisficers are focused on results being good enough (Schwartz, 2004). Under Schwartz's framework, one's personality type has a dramatic effect on the amount of regret one experiences. Maximizers tend to be unhappier and less satisfied with their choices for both of the reasons cited above: they easily construct counterfactuals about better outcomes and also heavily internalize any culpability for incorrect decisions. This leads them to be much more regretful than satisficers, who will be satisfied as long as the decision outcome is good enough.

Beyond the personality type of the individual, the choice situation itself can have dramatic implications on the extent of the regret. If a decision is made under time-stress, it can reduce the mind's information processing capability and therefore encourage bad judgments (Ariely & Zakay, 2001). Urbany points out that decisions made under uncertainty can cause people to do more intense, albeit worse, analysis, and therefore might heighten the impact of the personal accountability cause of regret (Urbany, Dickson, & Wilkie, 1989).

The size of the choice set can also directly impact the degree of the regret. Anderson explains that as the number of choices increase, the perceived differences between the various

choices diminish (Anderson, 2003). Thus, it becomes easier to construct post-facto counterfactuals that will increase decision regret. Schwartz similarly contends that more choices will equal more regret because the individual will have to turn down more options, thus increasing their personal responsibility for the incorrect decision (Schwartz et al., 2002). Payne argues that a larger choice set requires more effort to make a decision, and therefore makes the decision maker more vested in the decision outcome (J. Payne, 1992). Besides the size of the choice set, the structure of the choice set can also trigger feelings of regret. The placement of items within a set as well as the shared features of the item in the set can blend the differences between the various choices, and can thus trigger more counterfactual thinking after the purchase (Houston, Sherman, & Baker 1991; Zhang & Fitzsimons, 1999).

As mentioned above, regret is useful after the decision to prevent similar mistakes in the future. But research also shows that anticipated regret can actually affect a decision before it is made. More specifically, in some situations people will make a decision based on whether they think they will experience regret in the future because of their current dilemma. This phenomenon has been highlighted in numerous cases. Anticipated regret has been documented as having a significant impact in financial decisions (Barberis, Huang, & Thaler, 2006; Muermann, Mitchell, & Volkman, 2006) as well as insurance decisions (Braun & Muermann, 2004). Additionally, it has been shown to play a role in newsvendor models (Perakis & Roels, 2008) and, as one would intuitively expect, it considerably influences decisions made at auctions (Engelbrecht-Wiggans & Katok, 2008).

Synthesis of Literature and Hypothesis:

The hypothesis for our experiment was based on the research presented above on the two topics of cognitive loads and decision regret. The two causes of regret, counterfactual thinking

and personal accountability, are only relevant given a certain amount of memory capacity. The mind can only construct counterfactuals when it has enough working memory to process the other options. Similarly, individuals will only feel accountable for a decision when they have enough working memory to cogitate and feel invested in the decision. Without the fundamental capacity to effectively process a decision, the mind will use affect or similarity-based judgments and not be as vested in the outcome.

One's working memory capacity, as mentioned above, can be constrained both internally and externally and also varies across individual and situation. Internally, the strength of one's memory in a vacuum is different for different individuals, as evidenced by the range given to Miller's claim of seven chunks, plus or minus two (Miller, 1956). Similarly, there are countless forms of distractions, some of which were mentioned above, that can restrict individual's immediate processing capacity. These distractions were shown to affect decision strategies and impact actual decisions, and that these distractions could impact levels of decision regret therefore is a real possibility. Ideally, given a more thorough understanding of the interaction, individuals can optimize their decision processes to minimize regret.

Our hypothesis is that if an individual has a limited working memory capacity during a decision, then he or she will experience less decision regret regarding the outcome of the decision. We propose this because we believe having less available working memory will lessen an individual's personal accountability during the decision process and also restrict his or her ability to construct counterfactuals triggering regret.

In order to test this hypothesis, we constructed a study in the Wharton Behavioral Labs that would search for an interaction between these two factors. We modeled our study on Iyengar & Lepper's chocolate experiment during which they tested for decision regret based on an

extensive-choice set and a limited-choice set (Iyengar & Lepper, 2000). We then added an additional condition by randomly assigning half of the subjects a cognitive load to test for an interaction. In theory, we planned to replicate an existing regret experiment and then manipulate the results with an additional condition of a cognitive load.

Method:

254 University of Pennsylvania students participated in the study: 64 participants in the extensive-choice no cognitive load condition, 64 participants in the limited-choice no cognitive load condition, 63 participants in the extensive-choice cognitive load condition and 63 participants in the limited-choice cognitive load condition. To avoid any subject who didn't like chocolate, and would therefore skew the results of the study, participants were prescreened with questions of "Do you like chocolate?" and "How often do you eat Godiva chocolates?" If the subject responded that they did not like chocolate, or that they frequently ate Godiva chocolate, they were excluded from the study for fear of their tastes altering their behavior. 87% of the subjects, or 221 total subjects, participated through the entire study.

The questions included in the questionnaire precisely mimicked the questions in Iyengar and Lepper's study to gather similar data. All questions were answered using a 1-7 Likert scale. Participants were introduced to the study with an initial question that read "Please take a few moments to memorize the following number. You will be asked to recall this number later in the experiment, and will be compensated an additional $1 for a correct answer." They were randomly assigned to memorize either an 8-digit number to memorize (13773478) or a 1-digit number (6).

Participants were asked "How much did you enjoy making the choice?", "Did you find it difficult to make your decision of which chocolate to pick?", and "How frustrated did you feel

when making the choice?" to determine how the subjects perceived the choice-making process. They were also asked "How satisfied to do you think you will be if you sample this chocolate?" in order to see how satisfied the subjects predicted they would be if they were allowed to sample the chocolate.

The subjects were then asked "How confident are you that this chocolate will satisfy you?" and "How confident are you that this chocolate will be among the best you've ever had?" These two questions attempted to highlight the behaviors of the subjects as satisficers acting to seek any satisfactory option or maximizers acting to optimize the very best outcome. To test the perception of the subjects regarding the decision process and whether their decision was an accurate representation of how they would normally act, the subjects were asked "Do you feel that you made a well-informed decision on the chocolate you picked?" and "Is this a chocolate that you would normally pick?"

In addition to the questions regarding the process of choosing a chocolate, the subjects were also asked about their experience tasting the chocolate itself. They were asked about their satisfaction with the chocolate, regrets about the chocolate, and their satisfaction with the number of choices presented to them. The survey included questions of "How satisfied were you with the chocolate you tasted?", "How much did you enjoy the sample you tasted?", and "How tasty was the chocolate you sampled?" Additionally, the subjects were asked "How much do you regret eating the chocolate you tasted?" and "Do you think that there were chocolates on the table that tasted much better?" Lastly, subjects were asked "When initially given the task to pick a chocolate from the display, do you think the selection should have included more kinds of chocolates?"

Procedure:

The study was conducted in a laboratory setting at the Wharton Behavioral Labs. Participants entered the lab and were seated at a personal cubicle. They were then introduced to the experiment as a study about memory strength and consumer choices and asked to memorize either an 8-digit number (13773478) for the cognitive load condition or a 1-digit number (6) for the no cognitive load condition. They were informed that they would be asked to recall the number later in the survey, and would be given an extra $1 if they remembered it correctly.

The participants were then shown the following vignette: "We're doing a marketing research study that examines how people select chocolates. Please raise your hand to signal the attendant to come over. Please take a look at the names of the chocolates and the chocolates themselves, and tell the attendant which one you would buy for yourself." The participants selected their chocolate from a table in the lab room. In the limited-choice condition, the 6 flavors of chocolate were set up in three rows of two types of chocolate, whereas in the extensive-choice condition the 18 flavors of chocolate were set up in three rows of six types of chocolate. In the limited-choice condition, the chocolates were rotated such that all flavors of chocolate in the extensive-choice condition also appeared in the limited-choice condition.

After the participants selected the chocolate they would theoretically taste, they completed the questions about the decision process and about their anticipated satisfaction from the chocolate. The participants were then given the chocolate they selected to taste, and answered the remaining questions on the questionnaire about their actual satisfaction with the chocolate. Lastly, the participants were relieved of their cognitive load and were asked to report the number they memorized at the beginning of the study.

Results:

The number of choices did have an effect on participants' perceptions of the study. Participants in the extensive-choice conditions said that they had "too many" choices (M=4.90, SD=1.28) while participants in the limited-choice conditions said that the number of choices was "about right" (M=3.78, SD=1.14). This confirms that the individuals still felt overloaded despite only being presented with 18 options in the extensive-choice condition (unlike the 30 used in Iyengar and Lepper's study). The cognitive load had no significant effect on these perceptions within the choice-condition.

Similar to Iyengar and Lepper's study, the results showed that all participants were more confident that their chocolate would be satisfactory to them (M=5.81, SD=1.05) than that their chocolate selection would be among the best they had ever had (M=3.84, SD=1.60), $F(1, 440)=234.83$, $p<.0001$. Thus, the data does not show that the cognitive load or the choice-conditions promoted maximizing or satisficing behavior.

There were no significant differences between conditions about the level of anticipated satisfaction of the choice of chocolate. Similarly, there were no significant reported differences between conditions regarding how well-informed participants felt or whether this was a chocolate they would normally pick.

Participants in the extensive-choice condition (M=5.56, SD=1.17) actually enjoyed the decision process significantly more than those in the limited-choice condition (M=4.82, SD=1.19), $F(1, 222)=30.17$, $p<.0001$, consistent with Iyengar and Lepper's findings. Similarly, subjects in the extensive-choice condition also found the process more difficult (M=4.35, SD=1.81), (M=2.91, 1.72), $F(1, 219)=35.02$, $p<.0001$. Unlike Iyengar and Lepper's results, though, participants in this study did not find the extensive-choice condition significantly more

frustrating (M=2.26, SD=1.52), (M=1.74, S=1.32), F(1, 219)=3.55, p= .06, *ns*. In each of these tests, the cognitive load did not have a significant impact on the participants' reports.

To determine the satisfaction and regret levels of the participants across all four conditions, we created one composite measure of satisfaction. This was done by averaging the responses to the questions regarding tastiness, enjoyment and satisfaction (r= .90, .92 and .93) post-sampling along with the responses to the two questions regarding regret (r=.33, which were coded negatively). We then conducted ANOVA statistical tests across conditions, but found no significant differences across the cognitive load conditions or even across the extensive and limited-choice conditions.

The lack of results in support of the hypothesis can be thought about in a few ways. On the one hand, the results may simply show that there isn't a significant interaction between cognitive loads and decision regret, despite the research cited above that would seem to support the hypothesis. On the other hand, perhaps there was a flaw in the experiment that made the results insignificant.

The experiment did not trigger regret in significantly different degrees across the extensive-choice conditions and limited-choice conditions as it had in Iyengar and Lepper's original study. The cognitive load was therefore irrelevant because the base experiment was unsuccessful in eliciting testable results in the first place. This could be a flaw in experiment design, as slight modifications were made to the experiment. For example, in Iyengar and Lepper's study the subjects were led through a series of rooms at each stage in the experiment, while in this study they were seated at a cubicle for the majority of the study. Additionally, in Iyengar and Lepper's study the chocolates were presented in one row of six or five rows of six, while in this study the chocolates were presented in three rows of two or three rows of six.

Across all of the questions, the cognitive load did not have a significant impact in and of itself across the two extensive-choice conditions or across the two limited-choice conditions. This absence was particularly apparent in the final regret analysis that directly related to our hypothesis, but that might have been a function of the failure of the underlying experiment and not evidence in support of the null hypothesis. Further research is required to properly determine the extent of the interaction between cognitive loads and decision regret.

Discussion and Conclusion:

This study analyzed the existing literature on two major fields in psychology: cognitive load theory and decision regret. Cognitive load theory attempts to manipulate people's working memory capacity to perform better at particular tasks. People are often distracted or overworked, and by understanding how these cognitive loads function in relation to people's decision processes and learning abilities we can improve and optimize those situations. Scholars differ as to the internal capacity of the working memory, but all agree that there is a range of internal capacities alongside a host of external restrictions on total working memory ability.

The mechanism of a cognitive load can be thought about in two different ways. The first way cognitive loads are impactful is by shifting the mind from a rule-based decision strategy to a similarity-based strategy, which can be helpful for mindless tasks like playing golf but hurtful for complex tasks like driving. Another way cognitive loads are impactful is by promoting more affective and impulsive decision making over cognitive and deliberative decision making. This was tangibly portrayed in the experiment of the fruit salad and chocolate cake. In either framework, the cognitive load restricts the processing capacity of the mind and furthers heuristics as the best available decision strategy.

At the same time, the literature surrounding decision regret is extensive as well. Regret serves an important role by forcing individuals to reflect on previous mistakes and learn not to repeat them. Regret can be triggered by both acts of omission and acts of commission, on both a large scale regarding life decisions and also a small scale regarding individual consumer purchases. The feeling of regret is triggered by both a sense of personal accountability for a poorly made decision and the ability to recall better potential outcome counterfactuals. Regret can be magnified based on time urgency, emotional situations, or the nature of the choice set.

The question we investigated in our experiment was regarding the extent of the intersection between these two fields of study. Cognitive loads have been documented to impact decision processes (by switching to similarity-based or affective judgments). How would a cognitive load impact an individual's decision regret levels? We hypothesized that because a cognitive load would distract an individual, he or she would not feel as vested in the decision and thus would not feel as personally accountable or, by extension, as regretful. Similarly, we proposed that because the individual's working memory was constrained, he or she would not be able to as easily construct counterfactuals and therefore also be less regretful.

We tested this hypothesis by modifying an existing experiment done by Iyengar and Lepper that tested decision regret and adding a condition of a cognitive load. The experiment failed to show any significant correlation between the cognitive load and other variables in the experiment, including the anticipated satisfaction, the enjoyment of the decision process, and the frustration with the process of the participants. More importantly, though, the experiment failed to show any significant correlation between the cognitive load and levels of decision regret. This could simply be a result of there being no interaction, but underlying the data it became clear that the experiment itself failed to trigger the appropriate discrepancies even while ignoring the

cognitive load condition. The difference in regret between the extensive-choice condition and the limited-choice condition was insignificant, unlike Iyengar and Lepper's results. Given that platform, the cognitive load test was not able to prove any sort of interaction or absence thereof.

Given the demonstrated impact of cognitive loads on abstract decision strategies, we still believe intuitively that there is some connection between the two phenomena. Further research is needed to determine the extent of this connection and to determine the accuracy of the hypothesis presented above. Critical to the success of said research is a baseline experiment that triggers discernible regret across conditions.

We presented the sentiment that consumers equate freedom with happiness, and that recent research has served to debunk this myth by showing psychologically how more choices can create more decision regret. On a philosophical note, this idea of the tyranny of freedom is echoed by Isaiah Berlin (Berlin, 1958). In his work *Two Concepts of Liberty*, he discusses the difference between positive and negative liberty: positive liberty (or positive freedom) is the ability to choose what one wishes according to one's capabilities, while negative liberty (or negative freedom) is the autonomy to choose what one wishes free of external constraints. The idea that freedom equals happiness is assuming a particular type of freedom; specifically, it is assuming negative freedom from any constraints. This manifests itself in unlimited options in any decision, but also, as we have seen, in higher levels of decision regret. Perhaps by promoting a broader definition of freedom as positive liberty, individuals will recognize that true freedom lies in our ability to choose, not in the external limits set on our choices. Limits are not inherently bad, and can actually serve a real function by reducing our decision regret. By shifting our focus to a positive definition of freedom and choice we can create a more satisfied culture and society.

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