Understanding the Interplay between Cognitive Biases and Heuristics in Consumer Behavior

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Abstract

Understanding human decision-making procedures commenced during the mid-20th-century cognitive revolution. The interplay between cognitive biases and heuristics in consumer behavior is investigated in the present study. We show that heuristics and biases significantly affect how people make decisions by using data from an online poll with five different groups of Chinese and Korean high school and college students and using differences in how much time they spent on different cognitive events. Our results confirm the theory that biases and heuristics can cause illogical decisions. The rise in irrational decisions is especially noticeable when scarcity strategies are mixed with loss aversion. Further investigation shows that the mix of cognitive biases and heuristics significantly influences purchasing decisions, producing more irrational conclusions than depending on heuristics. These findings provide a deeper understanding of consumer behavior and the role of cognitive biases, enlightening the academic and professional community in this field.

Key words: Consumer Behavior, Heuristics, Cognitive Bias, Confirmation Bias, Anchoring Effect, Loss Aversion,Scarcity Heuristic, Decision-Making, Behavioral Economics, Irrational Judgments, Consumer Psychology, Quantitative Analysis, Qualitative Analysis.

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1 Introduction

Human nature is naturally full of decisions, especially in consumer behavior, where heuristics greatly influence decisions and assessments. Many elements affect the decision-making process in the complex terrain of human cognition; heuristics are one important mechanism. These mental shortcuts are ingrained in our daily lives and help us make quick decisions, particularly under time constraints and little knowledge. Heuristics can introduce systematic biases, even if they usually aid people in making wise decisions. These prejudices develop when people mistakenly think their ideas somewhat capture reality when they don't. Manifesting in several forms, these heuristic biases influence our decisions and cause logical mistakes. Improving decision-making depends on an awareness of the dual character of heuristics—their advantages and drawbacks. We can better negotiate the complexity of our cognitive nature by realizing the environments in which heuristics are beneficial and those that delude us.

Mainly concentrating on confirmation bias, loss aversion, the anchoring effect, and scarcity heuristics, our research explores the interchange between cognitive biases and heuristics in consumer behavior. While anchoring induces people to depend mainly on the first piece of information they come across when making decisions, confirmation bias drives them to search out data supporting their preconceptions. Loss aversion clarifies the phenomenon whereby the psychological impact of losing is more significant than that of pleasure or acquisition. The scarcity heuristic is a theory explaining why people cherish something seen as rare more than others perceive it as ordinary.

This study's inspiration comes from a discrepancy found in the body of current knowledge. Although earlier studies on entrepreneurial cognition have discussed these prejudices and heuristics, their influence on customer behavior has to be given more attention. We aim to better understand how these cognitive mechanisms affect consumer decisions by spotlighting these features. Academics and professionals use this knowledge to implement better marketing strategies, improve customer welfare, and make quick decisions. Our research's practical implications empower professionals to apply these findings to their work, enhancing their ability to understand and influence consumer behavior.

2 Literature Review

In the broad spectrum of behavioral economics, numerous studies have investigated the affinity between the correlation of diverse factors from multiple disciplines, such as economics, psychology, neuroscience, etc. Our paper focuses on consumer behavior, specifically scarcity heuristics, anchoring effects, loss aversion, and confirmation bias from the heuristics and cognitive biases categories. This literature review synthesizes several fundamental studies' findings, methodologies, and limitations to understand these phenomena comprehensively. The comprehensive nature of our literature review instills confidence in the validity and reliability of our research.

Scarcity Heuristics

The scarcity heuristic, a psychological concept, shapes consumer behavior by increasing the perceived value of limited-supply commodities. Many times, this cognitive shortcut fuels urgency in purchase decisions. Gupta (2013) shows how anticipated regret and competitive behavior brought on by perceived scarcity could drive impulsive buying. Scarcity has a complex effect on customer behavior that reveals itself in premature purchases, in-store stockpiling, and product concealment. Although stores can leverage this heuristic to increase sales, over-use of this method could lead to negative consumer experiences. Choi's (2014) studies show how the scarcity heuristic momentarily improves product allure, influencing customer interaction with social commerce sites. These studies emphasize the importance of precise scarcity-based marketing techniques and the prominent role scarcity plays in determining consumer behavior.

Loss Aversion

A fundamental cognitive bias, loss aversion, drives people to favor avoiding losses over obtaining comparable rewards. Kahneman and Tversky's Prospect Theory—which clarifies decision-making under uncertainty, loss, gains, and risk—is based on this theory (Kahneman & Tversky, 1979). According to Kahneman et al. (1991), loss aversion might cause one to value objects excessively and oppose constructive changes. Loss aversion also affects policy development and investment decisions in multiple consumer environments. Recent Liang (2023) experiments illustrate the relationship between risk-taking behavior and perceived scarcity, emphasizing the link between loss aversion and other cognitive distortions. These findings underline the requirement of loss aversion in decision-making processes and highlight the need for strategies to mitigate its

influence on consumer behavior and policy development.

Anchoring Effect

The anchoring effect is the predisposition to base most decisions on the first information—the "anchor.". Tversky and Kahneman (1974) demonstrated how arbitrary numerical anchors could influence later estimates, emphasizing the existence of this effect. Anchoring appears in consumer environments relating to price policies and impressions of quality. Ariely et al. (2003) authenticated that early anchor pricing significantly affects consumers' willingness to pay even for unknown products. Our work adds to the body of knowledge by examining the association between anchoring and other cognitive distortions in consumer decision-making. We observed data from five groups and found that anchoring, combined with loss aversion and scarcity strategies, leads to even more illogical results than heuristics alone. These findings emphasize the complexity of human decision-making and the significance of knowing how cognitive bias interacts to shape consumer behavior.

Confirmation Bias

Confirmation bias is the cognitive tendency wherein people disregard contradicting evidence while seeking, interpreting, and remembering data that supports their current ideas. This inclination significantly affects customer behavior, especially regarding brand loyalty and product selection. Although not explicitly addressing confirmation bias, linked studies offer insightful analyses of similar cognitive tendencies. Examining the status quo bias, Kahneman et al. (1991) find people actively searching for data to support their present decisions or situations. Similar to confirmation bias, this can lead to opposition to change and favoritism for material confirming current beliefs or circumstances. The endowment effect, or people overvaluing their possessions, further reinforces confirmation bias. Predicting and influencing judgments in several spheres, including consumer behavior, financial decision-making, and policy development, depends on an awareness of these connected prejudices. This information helps experts in their domains better control and mold human behavior.

Anomalies: The Endowment Effect, Loss Aversion, And Status Quo Bias, Kahneman (1991)

Kahneman, Knetsch, and Thaler (1991) investigated fundamental ideas for analyzing deviations from traditional economic models of consumer behavior, including the endowment effect,

loss aversion, and status quo bias. The study underlines the inclination of people to value their possessions more than items they do not own (endowment effect), the fact that the suffering of losses is more important than the pleasure of gains (loss aversion), and the inclination of people to maintain their present situation rather than embrace change. To demonstrate these behavioral abnormalities, the authors primarily review current experimental studies. For instance, the authors look at a study in which participants had to choose between a lottery ticket or $2, and they were generally unwilling to trade their selected choice for the other, even if both options had identical worth (Knetsch, 1984). This exemplifies the endowment effect—that ownership raises the value of an object. A different experiment revealed that the negative value of surrendering an object exceeds the positive value of obtaining it, demonstrating loss aversion. The idea mentioned is critical in prospect theory, a theoretical framework used to understand decision-making in situations involving risk. The research also examines the relationship between the endowment effect and loss aversion, elucidating how the hesitancy to relinquish things can be related to the more substantial psychological impact of losses compared to gains.

Notably, in their 1991 paper, Kahneman et al. did not adequately address anchoring and confirmation bias concepts. These cognitive distortions might affect loss aversion and the endowment effect. Further research may investigate how these prejudices affect people's evaluations of owned objects and risk-based decision-making.

These noted behavioral abnormalities contradict the conventional economic theory of stable preferences and logical decisions. Kahneman et al. (1991) stress the need for more studies to investigate these events in several settings and groups and to examine how these behavioral prejudices might be included in economic models. This demand for more research emphasizes the difficulty of human decision-making and the possible limits of traditional economic theories in fairly forecasting consumer behavior. The Psychological Effects of Perceived Scarcity on Consumers' Buying Behavior, Gupta (2013)

In-depth research by Gupta (2013) looks at how perceived scarcity, a marketing tactic that businesses frequently use, affects consumer purchasing behavior. The study examines consumer urgency and competitive behavior under supply-side scarcity—limited product availability. The investigation progresses through four distinct stages. At first, semi-structured interviews with six

shop managers from fashion stores such as H&M and Buckle were conducted. The purpose was to gather insights into how merchants interpret scarcity. Expanding on these discoveries and current knowledge, Study 2 polled 77 customers to investigate how the perception of scarcity affects their inclination to purchase things with a sense of urgency and their tendency to accumulate items in-store. Study 3 investigated these behaviors using in-depth interviews with fourteen consumers, an industry expert, and observational research. For statistical analysis, Study 4 employed an enhanced survey to examine the proposed model, which included 346 college students.

Although these results are significant, more research will be necessary to prove their generalizability over several retail contexts, including electronics, books, and e-commerce systems. Given the majority of female participants, one relevant issue concerns the application of these findings across sexes and other purchasing environments. Aware of the study's limitations, the authors note three interesting restrictions: reliance on a student-only sample, limited focus on fashion retail, and scant analysis of the long-term effects of the artificially produced shortage. These constraints highlight the need for more varied, long-term research to clarify how related cognitive biases and scarcity heuristics affect consumer behavior in many contexts. Future studies should solve these constraints, increasing our knowledge of consumer psychology in the always-changing retail environment. To test and expand these conclusions, future studies should aim for a more representative sample and investigate a broader spectrum of retail environments, improving our knowledge of consumer decision-making procedures in many scenarios in a dynamic marketplace.

Why Do People Visit Social Commerce Sites but Do Not Buy? The Role of the Scarcity Heuristic as a Momentary Characteristic, Choi (2024)

Choi's (2024) study seeks to decipher why customers swarm social commerce websites without buying intent. The paper explores the instantaneous effects of the scarcity heuristic, breaking out how time-limited offers and quantity restrictions affect the inclination to visit a site without always resulting in purchases. The researchers conducted a survey-based study with 350 South Korean respondents who were all seasoned users of social commerce platforms. To ensure diversity, the study used quota sampling. The poll addressed temporary and permanent characteristics, including discount rate, utility, trust, temporal and quantitative scarcity, and willingness to browse and buy via social commerce sites. The proposed research model was evaluated using structural equation

modeling, and the data was scrutinized. The study distinguishes between visit and purchase intentions, highlighting that scarcity heuristics such as limited-time offers and quantity constraints influence visits more than sales. The research seeks to bridge the gap between site views and actual sales by dissecting consumer behavior on social commerce platforms.

Limitations: The study's limited focus on Korean people with comparable cultural roots limits its generalizability and, therefore, restricts the results' relevance to other cultural contexts. Furthermore, several product features should have been considered in the study, such as whether it is more oriented toward offering enjoyment or functional usage. These qualities might provide a deeper insight into consumer behavior. To improve the overall results, research should consider product-specific traits and include a broader spectrum of cultural samples. Moreover, the study overlooked the long-lasting consequences of the scarcity heuristic on customer behavior in social commerce, providing an opportunity for more research.

The study discovered that transient characteristics like limited time, quantity, and transient discounts favorably influence people's urge to frequent social commerce sites rather than their propensity to make purchases. On the other hand, consistent features like perceived value, confidence, and discount rate help to favorably influence the desire to visit and purchase from these websites. These results show how different persistent traits and scarcity heuristics influence consumer behavior in social commerce environments. The results show that the scarcity heuristic momentarily influences consumer behavior, influencing their decision to frequent social commerce sites instead of their intention to buy. The study also showed that different factors drove visiting and purchasing intentions.

Observations: The study reveals that scarcity heuristics notably impact individuals' intentions to visit a place but do not significantly affect their intentions to purchase. Although scarcity can generate early curiosity and website traffic, more is needed to maintain the desire for actual purchases. This implies that the impact of scarcity is temporary rather than long-lasting.

Taking everything into account, the article offers an insightful analysis of how the scarcity heuristic and persistent features shape customer behavior on social commerce sites. The results directly affect social commerce site managers, who can create plans using the scarcity heuristic and other characteristics to attract and retain consumers.

To Take a Risk or Not? The Effect of Perceived Scarcity on Risky Choices, Liang et al. (2023)

Liang et al. (2023) empirically examined how people's inclination to take risks changes concerning their sense of shortage. The study examines whether scarcity conditions cause increased risk aversion by examining how remembering events involving limited resources affects decision-making in risk-related circumstances. Separated into two groups—the control group and the scarcity group—the participants, undergraduate Chinese students, were divided into control and scarcity groups. Whereas the control group remembered events of a neutral character, the scarcity group remembered past cases of resource inadequacy. The participants then had to choose from several uncertain options with varying probabilities and advantages, and they decided on either a safe or a risky one. The fact that the study depends on a homogeneous sample of Chinese undergraduates limits its applicability to a larger population. Moreover, the favorable presentation of bold choices affected the participants' responses, highlighting the need for different presentations in the following research. It is essential to consider socioeconomic levels and investigate several cultural environments to support the conclusions and grasp the broader effects of risk aversion from a shortage. The research acknowledges the following limitations: The study uses a student sample, thereby limiting the relevance of the findings. The study did not examine how purposefully manufactured shortages might permanently change consumer behavior.

According to the study, impoverished individuals generally exhibit greater risk aversion and pick safer options with guaranteed advantages over riskier ones. This falls under the scarcity heuristic theory, which states that people are more sensitive to probable losses in sight considering limited resources. These findings underline loss aversion's significance in decision-making, especially under limited circumstances. The interaction between loss aversion and scarcity shows the complexity of consumer behavior and emphasizes the requirement of using subtle strategies to grasp decision-making under limited resources.

Further discoveries:

The research evaluated how psychological traits affect behavior related to risk-taking. Risk attitude, urgency (an impulse component), and conscious action (a self-control component) were found to affect decision-making with dangerous options. Nevertheless, there were no significant differences in these psychological elements between the shortage and control circumstances, im-

plying that the variance in risk-taking could not be attributed to these elements. The study notably revealed no appreciable gender differences in risk-taking behavior. These results enhance our knowledge of human behavior in resource-limited circumstances and offer an insightful analysis of how perceived shortages affect risk aversion in decision-making.

3 Objectives & Hypotheses

3.1 Objectives of our research

Our study seeks to test the hypothesis that heuristics, while efficient for decision-making, simultaneously have the drawback of leading to irrational judgments. We propose that this effect is amplified when heuristics are combined with cognitive biases. We anticipate a higher likelihood of irrational judgments arising from the interplay of cognitive bias and heuristics. Our objective is to investigate and substantiate these hypotheses.

Previous papers have primarily focused on the individual effects of heuristics or biases. In contrast, we will examine the interaction between heuristics and biases, exploring whether these intertwining results in positive or negative outcomes rather than assessing each concept in isolation. The anchoring effect, for example, has been shown to significantly influence consumers' willingness to pay and accept prices, especially when uncertainty is involved (Simonson & Drolet, 2004)

Our study will analyze consumer behavior across various contexts, emphasizing consumer behavior toward snacks, which represent a consumable and temporary good. Unlike prior studies that often utilized expensive, semi-permanent items such as sneakers and clothing, we chose snacks because they can be purchased in larger quantities and offer more frequent opportunities to observe varied psychological effects. This approach allows us to compare the statistical outcomes of situations where only heuristics are applied versus those where both heuristics and biases are combined. This comparison is crucial as heuristics like scarcity can significantly affect consumer decisions, especially when combined with cognitive biases such as loss aversion (Kahneman et al., 1982)

Liang et al. (2023) found that scarcity heuristics and loss aversion deter people from taking risks. Contrary to this, our hypothesis suggests that scarcity heuristics and loss aversion will en-

courage risk-taking. Demonstrating this will be a crucial aspect of our study. The discrepancy arises from the different nature of the materials involved; whereas Liang et al. (2023) focused on the monetary value, our study uses a tangible product. We hypothesize that when the material context is shifted to consumable goods, individuals will overlook the monetary loss and be more inclined to purchase more despite the financial implications.

Our search aims to address and refine the limitations identified in previous papers. First, we will integrate qualitative research with quantitative methods. Unlike earlier studies that relied solely on quantitative approaches, our methodology includes asking participants to elaborate on their reasons for their choices. This allows us to perform both a straightforward analysis of responses and a more profound psychological examination of the participants' reasoning. By doing so, we can overcome various shortcomings associated with purely quantitative research, such as dishonesty, lack of depth, and neglect of non-quantifiable factors and emotions. Second, while previous studies often employed hypothetical scenarios and controlled experiments that may not have fully apprehended real-world behaviors, our research presents scenarios that closely mirror actual marketing strategies used by brands. We specifically concentrate on consumer demand-driven scarcity to address the shortcomings of studies that primarily emphasize "supply-side scarcity." (Choi, 2024) Thirdly, our study maintains a balanced gender ratio, with 24 female and 22 male participants, thereby eliminating generalization issues related to gender imbalance often seen in other studies. Fourthly, while prior research frequently focused on fast fashion retailers, our study explores consumer behavior within the food industry, particularly with snacks. This new context and category enhance the potential for broader generalizability of our findings (Gupta, 2013). Fifthly, whereas many studies involved diverse age groups and cultural contexts, our research targets a specific younger demographic: Korean and Chinese students aged 15 to 29 from international schools. This focused approach allows for a thorough analysis of a specific target group, minimizing variability due to cultural differences. However, our study specifically targets a younger demographic, consisting entirely of Korean or Chinese students aged 16 to 29 from international schools. This identity of cultural background and age group allows us to control potential variables that may arise due to cultural differences, allowing for in-depth and intensive analysis of this particular group. Although studies associated with entrepreneurship predominantly employ Likerscale, usually ranging on a 5-point scale, our approach uses only dummy variables, or binary options, to

enhance the validity of the data as well as facilitate the data analysis process.

3.2 The reason why these heuristics and biases combine well

To begin, it is crucial to analyze the interplay between the anchoring effect and confirmation bias. The anchoring effect and confirmation bias form a strong combination that greatly affects consumers' decision-making. The anchoring effect sets an initial reference point for a product, after which consumers rely heavily on these initial reference points to make decisions. This initial reference point, or "anchor," has a palpable influence on the process of consumers' recognition and evaluation of products, and often drives irrational decisions if the anchor is arbitrary or misleading (Tversky & Kahneman, 1974). During this process, the addition of confirmation bias further reinforces their tendency to rely on their fixed notion, making consumers find, interpret, and remember information that confirms their preconceived notions made through the anchor. This selective perception creates a looping effect, a phenomenon in which consumers experience difficulties in considering new information, especially contradictory information to their initial conception (Simonson & Drolet, 2004). In essence, anchors give consumers a basis for making decisions; confirmation bias helps them to remain at this starting point. While this mix of confirmation bias and anchoring effects helps consumers make decisions more quickly and readily, it also perpetuates them to ignore crucial data that contradicts anchors, thereby rendering impetuous, often unreasonable conclusions. On the other hand, scarcity heuristics and loss aversion are well combined. Similar to anchoring heuristics and confirmation bias, when combined, these two factors induce consumers' irrational decisions. Scarcity heuristics make consumers increase their appeal to items by giving higher value to the limited items, causing them to feel fear of missing out (FOMO). When consumers purchase certain products, a cognitive bias called loss aversion works together, a cognitive bias in which consumers feel more about the pain of loss than the joy of acquiring the same value. With scarcity heuristics and loss aversion, consumers have a strong psychological tendency to avoid loss extremely, which in turn makes consumers purchase unnecessary items or overspend (Kahneman et al., 1982). A scarce product makes consumers aware of the potential loss of missing out and the resulting strong fear of future regret, strengthens their sense of urgency to purchase the product, and consequently makes them purchase it hastily.

3.3 Hypothesis - H1, H0

These hypotheses aim to investigate the combined effects of various heuristics and biases on consumer purchasing behavior.

H0: The combination of heuristics and biases does not result in any significant effect on consumer purchasing behavior, or it weakens the impact compared to when only one heuristic or bias is applied.

H1: Consumers in the control group make rational decisions regarding the purchase of a snack based on its price and their available budget.

H2: The anchoring effect from prior negative information leads to a reduced likelihood of purchasing the snack.

H3: The combination of anchoring effect and confirmation bias results in an increased proportion of consumers refraining from purchasing the snack, and those who do purchase buy fewer quantities.

H4: Scarcity heuristics increase the likelihood of purchasing the snack, irrespective of its high price.

H5: The combined effect of scarcity heuristics and loss aversion results in a higher proportion of consumers purchasing the snack in more significant quantities compared to other groups.

3.4 Potential outcomes and the reason why

Based on the objectives of our research and hypotheses, the following potential outcomes are proposed. We anticipate that consumer irrationality will be more pronounced when heuristics and biases are combined than when heuristics are applied alone (Kahneman et al., 1982). This study is divided into two main categories, and we will discuss the potential outcomes for each.

First, when anchoring effects and confirmation bias are combined, consumers will exhibit more irrational judgments than when only the anchoring effect is applied. When confirmation bias reinforces the initial negative information, it acts as an anchor, causing consumers to place too much weight on it and skewing their subsequent judgments (Gilovich et al., 2002). This combination distorts the value of the product; negative initial impressions due to anchoring effects cause con-

sumers to perceive the quality of the product as low, and confirmation bias leads to unreasonable evaluation of the value of the product by focusing only on information that supports this initial perception. Consumers ignore contradictory evidence and underestimate the product to undergird their initial biased perception. This biased perception leads consumers to have an unfounded distrust of certain products, ignoring alternatives that offer better value. This irrational cognitive judgment increases consumers' emotional investment, leading to long-term irrational judgments.

This process reduces cognitive dissonance and creates psychological stability, reinforcing the biases. Consequently, these biases combine sequentially: the anchor sets the initial judgment, and the confirmation bias filters and reinforces supporting information. Together, they simplify the decision-making process, reducing cognitive load and leading to quicker but less rational decisions.

Secondly, when scarcity heuristics and loss aversion are combined, consumers are likely to make more irrational decisions compared to when only scarcity heuristics are applied. In this combined situation, consumers experience heightened urgency and panic due to the fear of missing out and the aversion to potential loss, leading to impulsive purchasing decisions (Simonson & Drolet, 2004). This irrational state causes consumers to buy products without sufficient evaluation, resulting in impulsive purchases of items they do not need or truly want. Additionally, consumers may willingly pay significantly higher prices for items perceived as scarce, leading to excessive spending. Additionally, fear-driven consumers may engage in hoarding behavior by purchasing more than is necessary to prevent future regret. The combination of scarcity heuristics and loss aversion increases consumers' emotional responses and makes them judge by feelings of fear and anxiety rather than logic and reason.

These results are attributed to the cognitive mechanisms of scarcity heuristics and loss avoidance. Scarcity heuristics make consumers perceive that a limited item is more valuable and increase the sense of urgency to obtain it, making irrational decisions. Loss aversion causes emotional reactions, such as strong fear, to the possibility of losing something, and this fear and sensitivity of potential loss cause consumers to take immediate action, consequently preventing them from making rational decisions and prioritizing loss avoidance. Thus, these two processes inevitably come together and appear sequentially: scarcity increases risk perception of loss, and loss aversion increases strong emotional response to perceived risk. When the two work together, they create

cognitive short circuits that emphasize the immediate acquisition of a product, making consumers overlook the actual value or necessity of the product. As a result, the mutual reinforcement of the two creates a strong motive for immediate purchasing behavior, allowing them to make irrational decisions.

4 Methodology

4.1 Experiment Overview

This paper investigates how the interplay between heuristics and biases influences consumer behavior. To conduct a thorough study, we assimilated our experiment with insights from the literature review. Ariely (2008) highlighted the need for a careful balance between controlled experiments and naturalistic observation to understand consumer behavior in real-world scenarios. Our team comprises high school and college students with limited resources and no access to a professional laboratory facility, so we utilized an online survey method. This method enabled us to engage many participants and obtain results quickly. The survey was designed from a consumer perspective, requiring participants to make decisions based on hypothetical scenarios. To prevent bias, the survey did not reveal the experiment's objectives.

The main questions were formatted for statistical analysis with binary answer choices (No = 0, Yes = 1). Additionally, participants were asked to provide short written explanations for their choices, offering qualitative data to support the quantitative results. These qualitative responses were not included in the statistical analysis but were used to enrich the paper's Results section.

As mentioned in the Objectives section, we grouped the anchoring effect and confirmation bias to see how the confirmation bias further accelerates or decelerates the anchoring effect. We grouped scarcity heuristics and loss aversion to investigate how adding loss aversion to scarcity heuristics impacts consumer behavior. Therefore, there are five groups in our experiment: the control group, treatment group #1, treatment group #2, treatment group #3, and treatment group #4. The control group is the group where participants are not exposed to any heuristics (anchoring heuristics, scarcity heuristics) or biases (confirmation bias, loss aversion). Treatment group #1 is the group where the survey challenges the participants only to use anchoring heuristics, but

treatment group #2 is where confirmation bias and the anchoring effect are added. Treatment group #3 is the group exposed to scarcity heuristics, and treatment group #4 is the group with both scarcity heuristics and loss aversion.

Since it is impossible to test all five groups in one survey, a total of five different surveys were created. Although the situation and context of each survey were the same, the form of the questions differed depending on the group to test different effects of heuristics and biases. The basic context of the survey is: “The amount of money that you can spend a day is $25. You just woke up today and saw the news that said snack A is very delicious. You went to a market because you were hungry. You found snack A in the market, but it is quite expensive $3.” Then, at the end of each question, it asked participants whether they would buy snack A. In the question of the control group, there was no additional information other than the original context.

4.2 Operationalization of variables

4.2.1 Independent variables (X)

The experiment’s independent variables are four different heuristics and biases: anchoring heuristics, scarcity heuristics, confirmation bias, and loss aversion. Each was assessed through questions set within the same context but varied in form.

To measure the impact of the anchoring heuristic on consumer behavior without any additional bias (treatment group #1), the survey included the initial context followed by this added detail: "Yesterday, one of your acquaintances told you that snack A is awful." This detail was intended to invoke the anchoring effect, leading participants to base their decision on the negative opinion provided by Kahneman et al. (1991).

For the treatment group examining the combined effect of anchoring heuristic and confirmation bias (treatment group #2), the survey built on the previous question by adding: "Just now, you encountered an online advertisement on your phone that says snack A is delicious." This addition bears the purpose of introducing confirmation bias, which challenges participants to accept or deny new information regarding snack A as well as their pre-existing beliefs (Gupta, 2013).

To assess the effect of the scarcity heuristic without additional bias (treatment group #3), the

survey included the initial context with the extra information: "But before you came to the market, you read a news article that says snack A is a limited edition that is only available for the next three days." This was designed to trigger the scarcity heuristic This aims to drive participants to utilize the scarcity heuristic, due to its rarity (Choi, 2024).

Ultimately, to evaluate the effect of scarcity heuristics combined with loss aversion on consumer behavior (treatment group #4), the survey extended the scenario in treatment group #3 by adding: "Just now, you saw a bunch of people coming into the market to buy snack A." This scenario aimed to invoke loss aversion, prompting participants to buy the snack out of fear of missing out on the opportunity (Liang et al., 2023).

4.2.2 Dependent variable (Y)

The dependent variable in this experiment is whether the participant decides to purchase snack A. To measure this, each survey concluded with the statement, "Would you buy snack A?" Participants were asked to respond with either 0 (no) or 1 (yes). This straightforward question allowed participants to quickly conclude their decision-making process, reflecting the influence of the heuristics and biases applied during the survey.

4.3 Experimental Design

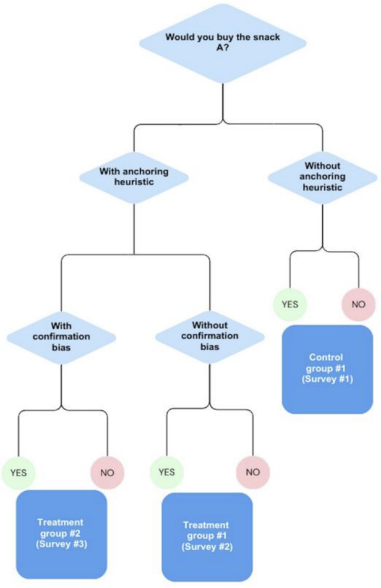

Figure 1: diagram of the survey for control group, treatment group #1, and treatment group #2

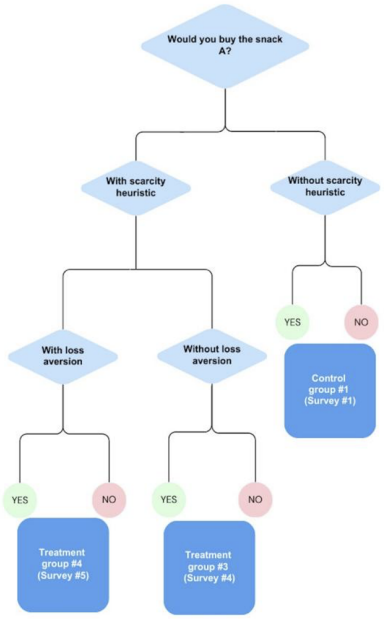

Figure 2: diagram of the survey for control group, treatment group #3, and treatment group #4

Figures 1 and 2 capture the basic structure of the survey. Figure 1 investigates the interplay between the anchoring heuristic and confirmation bias, while Figure 2 focuses on the scarcity heuristic and loss aversion. For the control group, participants will answer the question, "Would you buy snack A?" without any additional heuristics and biases. Treatment group #1 will answer the question with only anchoring heuristic, and treatment group #2 will answer the question with anchoring heuristic and confirmation bias. Treatment group #3 will answer the question with only the scarcity heuristic, and treatment group #4 will answer the question with the anchoring heuristic and loss aversion.

4.4 Sampling and Data Collection

The sample of this experiment comprises Korean and Chinese high school & college students who attended international school, whose ages ranged from 16 to 29. Ariely (2008) emphasizes the importance of considering cultural and demographic factors when analyzing consumer behavior,

as these can significantly influence decision-making processes. To prevent the participants from feeling overwhelmed and to allow them to complete the survey at their convenience, we employed the email survey method. This approach ensured that participants did not feel pressured to answer questions quickly, potentially affecting their responses. 5 surveys were sent to 45 high school & college students via email, and there were no incomplete answers among all the 45 answers from the participants. We decided to employ the email survey method to prevent the participants from feeling overwhelmed when they are being experimented on and allow them to fill out the survey whenever they want to, refraining from pressuring them to answer questions. At the beginning of the survey, before the actual experiment, we asked the participants if they agreed with us using their personal information in our research, and all 45 participants showed their consent. The number of samples is not equally distributed for each survey; all 5 surveys have different numbers of samples.

	Summary Statistics			
	Mean	St. Dev.	Min	Max
Buy the snack A (yes=1, no=1)	0.56	0.50	0.00	1.00
Anchoring effect	0.20	0.40	0.00	1.00
Anchoring and confirmation bias	0.18	0.39	0.00	1.00
Scarcity heuristic	0.31	0.47	0.00	1.00
Scarcity heuristic and loss aversion	0.13	0.34	0.00	1.00
Gender	0.53	0.50	0.00	1.00
Age	18.67	3.18	16.00	29.00

Table 1: Summary statistics of 45 participants

Table 1 indicates that, on average, 56% of the participants said that they would buy snack A. Furthermore, it shows that approximately 20% of the participants are in anchoring effect (treatment group #1), 18% are in anchoring and confirmation bias (treatment group #2), 31% are in scarcity heuristic (treatment group #3), and 13% are in scarcity heuristic and loss aversion (treatment group #4). The remaining 18% are in the control group. Specifically, 8 people are in the control group, 9 are in treatment group #1, 8 are in treatment group #2, 14 are in treatment group #3, and 6 are in treatment group #4. Table 1 also shows that there are more females in the participants, and the average age of the participants is 18 (round-up: 19). The maximum age of the participants is 29, and the minimum is 16.

4.5 Data Analysis Method

Data from the survey were comprehensively analyzed through a regression model in Excel. Before anything else, data were arranged in one complete table. In the x-axis was the dependent variable, buying the snack, 4 different independent variables, ages, and genders. The y-axis simply represented the response number in numerical series (1 to 45). After organizing the data table, the regression model was used to calculate the coefficients, standard errors, p-values, etc. Here, we did not calculate the regression of all data simultaneously but instead applied the regression model for each of the 5 groups and organized all the data in one table, Table 2. Ultimately, we ran the regression model on the entire data set with all combined variables (Table 3).

4.6 Equation

To complete exhaustive research on the relationship between heuristics and biases in consumer behavior, it is imperative to employ the econometric equation. The standard format of the econometric equation is stated as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \mu \tag{1}$$

Since we made a total of two groups (anchoring effect, confirmation bias, scarcity heuristics, and loss aversion) for the experiment, two separate equations are necessary to conduct a thorough analysis. For the first equation, the Y value would represent the dependent variable, purchasing the Snack A or not. α is the y-intercept,β_1 , $\beta_2$represents the slope, andX_1, X_2 are the two independent variables: anchoring heuristics, and confirmation bias, respectively. At the end μ is the unit for the error term. Applying these variables, the final equation looks like the following:

$$CB = \alpha + \beta_1 ANC + \beta_2 CON + \mu \tag{2}$$

where α is the constant term, β_1 is the coefficient of anchoring effect, and β_2 is the coefficient of confirmation bias. CB is consumer behavior, ANC is the anchoring effect, CON is confirmation bias, and $\mu$is the error term.Similarly, the second equation is:

$$CB = \alpha + \beta_3 SCA + \beta_4 LOA + \mu \tag{3}$$

Where α is the constant term,β_3 is the coefficient of the scarcity heuristic, and β_4 is the coefficient of loss aversion. CB is consumer behavior, SCA is the scarcity heuristic, LOA is loss aversion, and μ is the error term.

5 Results

In this section, we endeavor to scrutinize the relationship between the dependent variable, the tendency of people to purchase snack A, and the 4 independent variables: anchoring effect, anchoring effect and confirmation bias, scarcity heuristics, scarcity heuristics, and loss aversion. There are a total of two main processed data sets from this experiment, including Table 2, the regression model that calculates the coefficients and standard error for each of the 4 independent variables with respect to the dependent variable, and Table 3, the combined linear regression model with all four independent variables at once. In Table 2, each independent variable comprises 2 columns; the first column is the data without controls (gender, age), and the second is calculated with controls. As a result, each second column, column (2) (4) (6) (8), contains extra coefficients and standard error values for gender and age. The anchoring effect is in treatment group #1, anchoring and confirmation bias are in treatment group #2, scarcity heuristics are in treatment group #3, and scarcity heuristics and loss aversion are in treatment group #4.

	Anchoring effect		Anchoring and confirmation bias		Scarcity heuristic		Scarcity heuristic and loss aversion	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-0.292	-0.015	-0.375	-0.867	0.161	0.473	0.042	0.097
	(0.247)	(0.286)	(0.245)	(0.339)	(0.204)	(0.211)	(0.279)	(0.299)
Gender		-0.586		0.067		-0.268		-0.236
		(0.347)		(0.365)		(0.176)		(0.299)
Age		-0.035		0.267		-0.064		0.104
		(0.241)		(0.157)		(0.025)		(0.234)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Number of Observations	17	17	16	16	22	22	14	14
R square	0.085	0.289	0.143	0.424	0.03	0.328	0.002	0.09

Figure 1: **Table 2:** Regression table of the probability of purchasing Snack A concerning different heuristics and biases (standard errors are in parentheses)

5.1 Results from Table 2

5.1.1 Equation (2), treatment group #1 and treatment group #2

First and foremost, it is imperative to investigate the findings from Table 2, as it provides a specific data value that highlights how heuristics with and without biases influence consumer behavior. Column (1)(2)(3)(4) are within equation (2), (5)(6)(7)(8) are for equation (3). From column (1) of the anchoring effect, treatment group #1, the coefficient is rather -0.292. This outcome, which is statistically insignificant, suggests, nevertheless, no evidence of a significant anchoring effect on the purchase decision. Given lack of statistical significance, the observed coefficient should be understood as essentially zero. Lack of statistical significance suggests that the observed negative coefficient could be the result of random data variation; so, we are unable to assert that the anchoring effect reduces the likelihood of buying the snack. The coefficient lowers even more to -0.015 when additional controls are included in column (2). While still negative, this decline is statistically negligible, therefore supporting the idea that the data show no clear influence of the anchoring effect on purchasing decisions. These results thus imply, statistically, virtually no influence of the anchoring effect on the choice to buy the snack, in line with Kahneman et al. (1991), who underscored the need of considering statistical insignificance when analyzing empirical results.

For treatment group #2, in column (3), the coefficient value is presented as -0.375. Compared to that of column (1), it can be seen that the coefficient decreased even more, with a difference of 0.083. This implies that when participants are faced with the anchoring effect as well as the confirmation bias, it further influences their consumer decisions, ultimately leading them to not purchase snack A even more. Although the results indicate a potential trend consistent with our hypothesis, the statistical insignificance indicates we cannot conclude that adding confirmation bias to the anchoring heuristic significantly impacts the likelihood of buying snack A. The results should be seen as inconclusive, reflecting the lack of evidence for a real influence. These findings suggest that while there could be a trend, further research is required to prove a statistically significant impact. By adding confirmation bias, participants are more susceptible to the first piece of information and tend to reject other information that mismatches with their initial understandings of the snack. Interestingly, when data are combined with controls, in column (4), the coefficient increased much

higher, -0.867, almost doubling the value without controls from column (3). The direct effect of anchoring effect with confirmation bias, data shows, is even more influential with controls. This means that approximately 87% of the participants decided not to purchase the product with anchoring effect and confirmation bias, showing, again, that the interplay between heuristics and biases drives consumers to make irrational judgments (Gupta, 2013).

5.1.2 Equation (3), treatment group #3 and treatment group #4

The coefficient value in treatment group #3 of the scarcity heuristics column (5) is 0.161. This result is statistically insignificant, though, suggesting that we cannot establish that the likelihood of buying the snack is greatly influenced by scarcity heuristics. The observed effect may be the result of random fluctuation instead of true effect. Even with the controls combined, in column (6), the coefficient is still positive, and the value is even augmented to 0.473. Again, this underscores the idea that the scarcity heuristic serves as a catalyst to drive people to perceive snack A as an invaluable object and that the direct effect of the scarcity heuristic on people's tendency to buy snack A is prominent (Choi, 2024).

However, data from Columns (7) and (8), treatment group #4, demonstrate unexpected results that do not match our previous hypothesis and expected outcomes. Originally, our team surmised consumers with loss aversion and scarcity heuristics, treatment group #4, would risk more financially to obtain scarce items. By contrast, in column (7), the coefficient is 0.042, which is lower than that of column (6) with approximately 0.431. The difference is subtle, but it creates a new perspective; the addition of a new bias, loss aversion, pragmatically does not contribute to consumers' irrational decisions. Adding loss aversion resulted in a reduced coefficient, which indicates less likelihood of buying snack A. This statistically insignificant change, however, indicates that the decrease does not reflect a significant influence and may be the result of random chance. We conjectured people would purchase snack A even more when loss aversion is added as people would fear losing the opportunity to buy scarce items, but in fact, people would rather not buy the snack. When the controls are combined, in column (8), the coefficient becomes 0.097. The coefficient got closer to 0.161 from column (5) with the inclusion of controls, and this result further stretches the idea that loss aversion had a trifling impact on scarcity heuristics Liang et al. (2023).

	(1)	(2)
Anchoring effect	-0.292	-0.177
	(0.231)	(0.229)
Anchoring and confirmation bias	-0.375	-0.300
	(0.238)	(0.228)
Scarcity heuristic	0.161	0.465
	(0.211)	(0.229)
Scarcity heuristic and loss aversion	0.042	0.065
	(0.257)	(0.241)
Gender		-0.304
		(0.148)
Age		-0.060
		(0.027)
Controls	No	Yes
Number of Observations	44	44
R square	0.184	0.326

Figure 2: Table 3: Regression table of the probability of purchasing Snack A with all independent variables combined (standard errors are in parentheses)

5.2 Results from Table 3

Next, we investigate the relationship when including all treatments simultaneously. This table is significant in terms of discerning the general patterns of data sets and understanding how each independent variable impacts the dependent variable. Coefficients and standard error values without controls in column (1) from Table 3 are identical to those of Table 2, but values differ when combined with controls. Though this difference is still statistically negligible, the coefficient for the anchoring effect increased from -0.015 to -0.177 in column (2). This implies that there is insufficient strong evidence for an impact of anchoring heuristics on purchasing behavior from the observed pattern. Similar to the trend shown in Table 2, when participants were in a situation with additional confirmation bias, people preferred to not purchase the snack even more, as the value went from -0.177 to -0.300. The coefficient for the scarcity heuristics in column (2) is 0.465, which also increased from the data in Table 2, underlining that scarcity heuristics drive participants to willingly purchase the snack. Although the coefficient for loss aversion and scarcity heuristics increased slightly to 0.065, it is still statistically insignificant. Hence, in this context, we cannot

	Mean
Control group	1.50
Treatment group #1 (Anchoring heuristics)	3.40
Treatment group #2 (Anchoring heuristics + confirmation bias)	1.00
Treatment group #3 (Scarcity heuristics)	1.86
Treatment group #4 (Scarcity heuristics + loss aversion)	4.33

Figure 3: Table 4: Table of the number of snacks A participants are willing to buy for each group

assert that loss aversion significantly affects the effect of scarcity heuristics. The noted rise should not be taken as proof of a real influence. This also shows that the inclusion of loss aversion in scarcity heuristics did not encourage participants to buy more of the snack, as we had expected, but rather decreased the probability of participants purchasing snack A.

5.3 Results from Table 4

Since data in Table 2 and Table 3 do not directly demonstrate how much impact each treatment had on consumer behavior, we included additional questions, in which we asked the participants, "How many snacks would you buy." Ariely (2008) discusses how consumers often make irrational purchasing decisions based on perceived scarcity or social proof, which aligns with our findings in treatment group #4. This question facilitates the process of identifying the direct impact of each variable on consumer purchases, thus comparing consumer behavior with only heuristics and with heuristics as well as bias. From survey #1 for the control group, exactly half of the participants said they would purchase only one snack, while the other half said 2. These ambivalent responses indicate that the group without any treatment does not attempt to risk financially or decide not to buy the snack. Next, in survey #2 for treatment group #1, the majority of the participants, 50%, showed interest in buying 3 snacks, and the other 50% was equally distributed for 1, 2, 4, 5, and 7. However, when participants were in the context of confirmation bias as well as anchoring effect, 50% of participants said that they would purchase only 1 snack, a crucial phenomenon in this experiment. This decrease in the number of snacks that participants are willing to buy after adding the new bias supports our hypothesis, as the new bias made people stick with their initial piece

of information, thus rejecting any other information and ultimately deciding not to purchase the snack. For survey #4, treatment group #3, about 42.9% of the participants mentioned that they would buy only 1 snack, and almost 21.4% said 4. However, unlike data from Tables 2 and 3, survey #5 demonstrated that the addition of loss aversion increased people's tendency to purchase snack A; 33.3% of the participants said they would buy 8 snacks, and only 12.9% of participants said they would buy less than 3 snacks. Most likely, when participants were subjected to both scarcity heuristics and loss aversion, they unconsciously feared more of losing the opportunity to purchase snack A, therefore, they decided to buy many snacks even though they had to pay for relatively high prices.

5.4 Qualitative data

Our research employed both quantitative and qualitative methods. By asking respondents to provide reasons for their choices in the last question of the survey, we were able to conduct a psychological analysis of their decision-making processes.

In the control group, 62.5% of respondents indicated they would purchase snack A, while 37.5% said they would not. Most respondents provided complex, well-reasoned answers when asked why they made these choices. Those who chose to purchase snack A typically responded, "I want to try it because the news said it tastes good, I am currently hungry, and spending $4 on the snack leaves me with $21, which is sufficient for other daily activities for the rest of the day." Conversely, those who chose not to purchase snack A commonly replied, "Although the news said the snack is tasty and I am hungry, $4 is too expensive. With only $21 left, it would be tight to cover other daily expenses such as transportation, essentials, or cosmetics," or "I can afford the $4 expense out of $25, but I don't particularly like snacks and would prefer a meal when I am hungry." Analyzing these reasons, it is evident that the differences in responses to the question about purchasing the snack are due to individual variations in daily spending habits and preferences for snacks. Respondents considered various factors and made rational decisions based on their unique circumstances and preferences.

In Treatment Group 1, 40% of respondents indicated they would purchase snack A, while 60% said they would not. When participants were asked to provide rationales for their options,

the preponderance provided simple reasons rather than reasons derived from deliberations. Most respondents who chose not to purchase snack A had reasoned "Because my acquaintance said it doesn't taste good," or "My acquaintance said it doesn't taste good, and it's too expensive." On the other hand, the respondents who chose to purchase snack A provided reasons such as "Although my acquaintance said it doesn't taste good, I am curious about the taste," or "My acquaintance said it doesn't taste good, but I believe taste preferences vary, so I want to try it." These results show that, unlike the control group, often subjects in Treatment Group 1 made decisions through a relatively simple way of thinking, focusing on initial information provided by acquaintances rather than considering various factors.

In Treatment Group 2, 25% of respondents indicated they would purchase snack A, while 75% said they would not. This result shows an increase in the proportion of 'No' responses compared to Treatment Group 1. When asked to provide reasons for their choices, most respondents, similar to those in Treatment Group 1, gave relatively simple explanations. Similar to Treatment Group 1, the majority of respondents made straightforward decisions after focusing on the initial unfavorable information that their acquaintance had provided. However, the notable increase in the 'No' responses suggests that respondents reinforced the initial negative anchor through confirmation bias, ignoring positive information about the snack's taste and strengthening their initial perception.

In Treatment group 3, 78.6% of the respondents indicated they would purchase snack A, while 21.4% said they would not. This result shows that the proportion of respondents who chose to purchase snack A was significantly higher than the proportion of respondents who chose not to purchase snack A. When considering both the results and the answers to their reasons for their choice, we can draw that this is the result of scarcity heuristics affecting on the information that the snack is a limited edition and can only be purchased for three days in the situation most respondents presented. When asked to provide reasons for their choices, most of the respondents seemed to have decided on a quite simple reason rather than considering various factors; most of the respondents who chose to purchase snack A answered, "Because it's a limited edition" and "Limited edition gives value". This indicates that they focused heavily on the information that it was a limited edition and failed to consider various factors, resulting in unreasonable decisions made through a simple way of thinking.

In Treatment Group 4, 66.7% of respondents indicated they would purchase snack A, while 33.3% said they would not. This result shows that a significantly higher proportion of respondents within this group were willing to buy the snack. However, compared to Treatment Group 3, the proportion of respondents willing to purchase the snack slightly decreased, which does not align with our hypothesis. Nevertheless, analyzing their reasons for their choices reveals that most respondents, similar to Treatment Group 3, provided simple explanations. Those who chose to purchase the snack stated reasons such as, "Because a bunch of people are coming into the market," or "People are coming into the market." These reasons indicate that the presence of others entering the market to buy the limited edition snack triggered loss aversion in addition to scarcity heuristics, leading to irrational decisions based on simple reasoning without considering various factors.

6 Conclusion

Consumer behavior is ubiquitous, and everyone unanimously agrees that understanding the factors that drive purchasing decisions is critical in today's market-driven society. Understanding consumer behavior is crucial for companies in the modern market, as they constantly contend for customer attention. Investigating the elements impacting purchasing decisions enables firms to modify their marketing plans and improve client satisfaction. Corporate executives benefit from this information as researchers strive to inspire sustainable consumption practices. Understanding biases—including loss aversion and confirmation bias—helps consumers and companies render better decisions. This study clarifies how heuristics could help decision-making and bring prejudices that seriously affect behavioral economics. Awareness of these processes is crucial for maximizing heuristic benefits, reducing dire consequences, increasing consumer welfare, and forming marketing strategies. Thus, promoting general society's health, creativity, and progress depends on examining the intricacy of consumer behavior.

While some data trends appear to correspond to our hypotheses, the statistical insignificance of substantial findings limits our capacity to make definite conclusions regarding the effect of heuristics and cognitive biases on consumer decision-making. Further investigation is necessary to determine whether the observed trends reflect actual effects since random variation could be the cause of them. Although a negative coefficient for the anchoring effect was noted, the ab-

sence of statistical significance suggests that participants' decisions could not have been regularly influenced by the anchor. The results imply that instead of a real anchoring effect, the observed behavior could be explained by random chance; people exposed to initial information were less motivated to buy the snack. This aligns with past research showing how anchoring could distort following choices and hinder the rational thought process. This effect was particularly noticeable when combined with confirmation bias since participants actively searched for information to support their previous opinions, therefore reducing the likelihood of purchase. Likewise, the scarcity heuristic motivated impulsive buying behavior; participants saw the snack's limited availability as enhancing its worth, resulting in more rapid, impulsive purchases. Contrary to our expectations, the mix of loss aversion and scarcity heuristics did not considerably raise purchase likelihood. In contrast, loss aversion appeared to offset the urges driven by scarcity and help people to make more deliberate decisions. Nonetheless, the mix of loss aversion and scarcity influenced consumers to buy more of the products, thereby emphasizing the complex interplay among several cognitive distortions and heuristics.

In light of our findings, numerous aspects require deeper investigation. For instance, a broader sample of different age groups responding to cognitive biases and heuristics in their purchasing decisions? Are younger consumers more susceptible to the anchoring effect compared to older consumers? Would the results be identical even in longitudinal research? Future research ought to take into account employing various and representative samples as well as longitudinal approaches to capture the dynamic nature of cognitive biases across time to address these questions.

Including cross-cultural comparisons could also offer insightful analyses of how cultural settings affect susceptibility to certain biases. Expanding the scope of study in these directions will help us to better grasp cognitive biases and their implications for consumer behavior, hence guiding the development of more complex solutions for reducing their influence and supporting logical decision-making.

In Treatment Group 3, 78.6% of respondents indicated they would purchase snack A, while 21.4% said they would not. This result shows a significantly higher proportion of respondents willing to buy the snack compared to those who would not. Considering both this outcome and their reasons for their choices, it is evident that the scarcity heuristics played a significant role due

to the information that the snack is a limited edition available for only three days. When asked why they made these choices, most respondents provided simple explanations. Those who chose to purchase the snack predominantly stated, "Because it's a limited edition" or "Limited edition gives value." This indicates that respondents focused heavily on the limited edition information and made irrational decisions without considering various factors.

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