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Karen Kaiser
Banco de México

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Karen Kaiser†
Banco de México

Abstract

This paper analyzes the effect of information overload on preference or aversion for variety. According to the model, a rational decision maker who suffers from information overload, faces a two-stage decision process, and is choosing from a set of unknown goods will find it optimal at some point to become variety averse. To test this hypothesis, an experiment is conducted, and its results, that subjects suffering from information overload use variety aversion as a strategy to deal with their cognitive limitations, are consistent with the model. Moreover, results suggest that subjects are, on the average, choosing the optimal number of goods. As the price of the goods increases, subjects become more variety averse. In addition, as they become more experienced, they prefer larger sets of goods.
Keywords: Variety aversion, information overload, bounded rationality, decision making, laboratory experiment.
JEL Classification: C91, D81, D83.

Resumen

En el documento se analiza el efecto que una sobrecarga de información genera sobre la preferencia o aversión por variedad. De acuerdo al modelo, será óptimo para un agente racional, que tiene limitaciones para procesar información, que enfrenta un proceso de decisión en dos etapas y que está eligiendo de un conjunto de bienes desconocido, volverse adverso a la variedad. Para probar la hipótesis anterior, se realiza un experimento cuyos resultados son consistentes con el modelo: los sujetos utilizan aversión a la variedad como una estrategia para lidiar con su limitación para procesar información. Además, los resultados sugieren que los sujetos eligen, en promedio, el número óptimo de bienes a analizar y que al aumentar el precio de los bienes prefieren conjuntos más pequeños. Por otra parte, al aumentar su experiencia prefieren conjuntos más grandes.
Palabras Clave: Aversión a la variedad, sobrecarga de información, racionalidad limitada, toma de decisiones, experimento de laboratorio.

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† Dirección General de Investigación Económica. Email: kkaiser@banxico.org.mx.

1 Introduction

Experimental evidence suggests that the number of options consumers face may have a negative impact on satisfaction and buying behavior (Iyengar and Lepper, 2000; Shah and Wolford, 2007; Boatwright and Nunes, 2001; Reutskaya and Hogarth, 2009). Research further suggests that decision makers (DMs) might like to restrict their options; for example, there is evidence that students commit to certain deadlines (Ariely and Wertenbroch, 2002); that consumers voluntarily, and strategically, ration the purchase quantities of goods that may cause problems of self-control (Wertenbroch, 1988); and that subjects in an abstract setting sometimes prefer a subset of the larger set when choosing from lotteries (Salgado, 2006). Among the explanations for this evidence are the increased complexity of the cognitive process, self-control problems, cognitive overload, and regret (Gourville and Soman, 2005; Wertenbroch, 2002; Salgado, 2006; Sarver 2008).

In line with this evidence that DMs might like to restrict their options, in this paper I study preference for variety and, in particular, the effect of a specific cognitive limitation on preferences over sets. Following the neuroscience and psychology literatures, which suggest that subjects cannot focus on a specific set of information and that they are distracted by task-irrelevant information, I study the behavior of a DM who suffers from information overload. The DM is unable to focus on a specific subset of information and is even worse off when she has too much information.

On the one hand, neuroscientists have long studied the importance of staying focused in order to perform coherent cognitive functions, including the ability to remain focused on a task in the presence of distractors (Lavie, 2005). On the other, psychologists were the first to document that too much information can distract consumers, can create a cognitive limitation on processing information, and can cause consumers to make worse decisions. They called this phenomenon "information overload" (Jacoby, Speller, and Berning, 1974; Scammon, 1977; Muller 1984; Jacoby ,1984; Keller and Staelin, 1987).

Following the experimental literature on the study of strategic behavior in the presence of cognitive limitations (Camerer, Johnson, Rymon, Senkarl, 1993; Gabaix, Laibson, Moloche, Weinberg, 2006; Costa-Gomes and Crawford, 2006), I test first whether subjects suffer from information overload and then test whether subjects take into consideration their limited capacity to process information and maximize their utility by internalizing their cognitive limitation (for example, Simon, 1955).

The hypothesis tested in the experiment is based on a model where a rational DM suffers from information overload, faces a two-stage decision process, and is choosing from a set of goods of unknown quality. In the first stage DM has to choose how many goods she would like to receive information about. In the second stage, with the information she recalls, she chooses a good from those in her choice set.

At the beginning of the decision process DM only knows that quality is distributed uniformly, but with no information goods are ex ante identical. For each of the goods that belong to the set DM is considering, a bit of information will be generated that reveals the quality of the good. Once DM receives the information on each good in the set, she has to process it and then choose the highest-quality good. DM's cognitive limitation on processing information is modeled by endowing DM with a technology to process information. This is modeled as a function that, for every variety (size of set, n), determines the probability distribution over the number of bits of information that DM will be able to process. This function is known to DM, who incorporates it when choosing the size of the choice set.

As variety (the number of options DM considers) increases, so does the flow of information DM is receiving. If the rational DM suffers from information overload, her expected utility might start to decrease if variety is increased beyond a certain point. This suggests that for some number of options the DM should become variety averse. Theorem 1 shows that decreasing the expected total amount of information processed is sufficient to generate a preference for smaller sets.

To test experimentally the implications of this model, in the first treatment I study whether subjects suffer from information overload or not. In the treatments that follow I study the effects of the presence of this phenomenon on preference or aversion for variety.

In all treatments subjects will have to choose a good from a set of goods—defined as bundles of five attributes, where the value of each attribute is given to the subject but not the value of the good (this abstract setting is similar to Gabaix, Laibson, Moloche, Weinberg, 2006). Each good is a column with five entries, and the best alternative is simply the column whose attributes have the highest sum. At the beginning of the experiment subjects know that the value of each attribute is distributed uniformly over $\{20, ..., 100\}$.

To generate the limited capacity to process information, I use two common practices: first, in order to find out the quality of the good, subjects will have to perform the cognitive task of adding the value of the attributes; and second, subjects will function under a time constraint. There is a time limit for execution of cognitive operations; having less time than required for the task simulates a cognitive limitation (Neisser, 1963). To generate this limitation, subjects are given 25 seconds to select an object from the set; if time runs out before the subject makes a choice, her payoff for that round is zero. In each treatment, each subject plays for ten rounds.

To be able to study the subjects' preference or aversion for variety, in some treatments participants face a two-stage decision process: in the first stage, they can choose variety, that is, how many options they want to consider. In the second stage, they see the number of columns they chose in the first round and can pick one. For each good that belongs to the degree of variety they have chosen, the value of its five attributes appears on the screen. It is important to mention that all the information is displayed at the same time and remains visible while the decision stage lasts. The payoff of each round is the value of the chosen alternative multiplied by a conversion rate, known at the beginning.

In the experiment, I also analyze the effects of the DM's previous experience and of the decision process's complexity . To increase the complexity of the task, in some treatments I introduce a price (p), which imposes an additional requirement for subjects to receive a positive payoff: the value of a column chosen must exceed p. Intuition suggests that the more complex the DM's information-processing task the more likely DM will be to prefer smaller sets. Note that increasing the size of the choice set does not have an (explicit) cost; the price has to be paid only when a column is chosen in the second-stage decision.

The experimental results confirm the two main hypotheses of the paper: subjects suffer from information overload, and they rationally use variety aversion as a strategy to deal with this problem. Results from Treatment 1 show that as the amount of information increases, the performance of the average subject decreases. Moreover, it can be inferred that the number of columns that maximized the average payoff lay between 12 and 16, which is smaller than the maximum number of columns available (20). Results from Treatment 2, where subjects could themselves choose the extent of variety, confirm that subjects use variety aversion to deal with their cognitive limitation. Results also suggest that the average choice of variety belongs to the optimal range (12 to 16); this reveals that subjects are dealing strategically with their limitation on processing information and are optimizing correctly.

As the price subjects have to pay for consuming a good increases, their aversion for variety also increases. After playing ten rounds with no price, subjects face a price in the eleventh round, and as a result the average size of the set chosen is reduced from 12.25 to 7.2 columns. On the other hand, also as expected, experienced subjects prefer larger sets, and they perform better. This suggests that experience helps them improve their ability to handle more information and hence increase their payoff.

1.1 Related Literature

In contrast to previous literature on bounded rationality where DM can control which information to see and which information not to see while the choice set remains fixed (Gabaix, Laibson, 2003; Wilson, 2006; Gabaix, Laibson, Moloche, and Weinberg, 2006), in this paper all the information about the goods is displayed during the entire decision-making stage. This paper focuses on studying whether DM uses the strategy of decreasing her consideration set to control the information flow.

As does other experimental literature (Camerer, Johnson, Rymon, Senkarl, 1993; Gabaix, Laibson, Moloche, Weinberg, 2006; Costa-Gomes and Crawford, 2006), I analyze the strategy used by subjects in the presence of some cognitive limitations. However, in contrast to this literature, I do not study the algorithm used by subjects to process information; rather, I study whether subjects decrease the number of objects in their consideration set to complement whatever algorithm they are using to process information.

Most of the evidence on the effects of variety on satisfaction and behavior comes from studies where different choice conditions are given to subjects (Iyengar and Lepper, 2000; Shah and Wolford, 2007; Boatwright and Nunes, 2001). Once subjects go through the decision process, their behavior is analyzed. Salgado (2006) presents a different methodology, where subjects can choose between two different sizes of choice sets (in the first treatment, one choice set had five alternatives and the other twenty five; and in the second, one had five and the other fifty). However, as in previous literature, Salgado infers from subjects' revealed preferences over two possible choice sets, in different settings, whether or not they suffer from cognitive overload. The main methodological difference that distinguishes my paper from this literature is that I first test whether subjects suffer from information overload and then analyze their preference or aversion for variety (giving the subjects a large set of variety options to choose from). This allows me to establish a link between a specific phenomenon—information overload—and preference or aversion for variety.

The paper is organized as follows. In section 2 the formal model is presented. In section 3 the experimental design is explained and in section 4 results are presented. In the last section I conclude.

2 Model

The DM will choose a good from a set of unknown goods. She knows that the quality of the goods is uniformly distributed in the interval $[0, 1]$ but ex ante they are identical. The utility of consuming a good of quality q is $u(q) = q$, and the reservation utility is zero.

DM suffers from information overload. She has a limited capacity to process information and too much information can make her worse off. For each good that belongs to the choice set, a bit of information that reveals the quality of the good will be generated and received by DM. However, it might happen that DM will not be able to process all the information.

The capacity to process n bits of information $M(n) = b(n, \alpha(n))$ is modeled as a binomial distribution with parameters $(n, \alpha(n))$, where n is the support and $\alpha(n)$ is the probability of a success. In order to incorporate the fact that DM suffers from information overload, it is assumed that $\alpha(n)$ is strictly decreasing.

For example, if $M(n) = b(n, (1/n))$ and the choice set has two goods, two bits of information will be generated; however, probability is .25 that no information will be processed, .5 that DM will process information about the quality of only one good, and .25 that she will process information about the quality of both goods.

When DM processes information about some number of goods, she will always choose the good with the highest quality. The ex ante expected utility of processing ℓ bits of information is the expected value of the maximum of ℓ draws from a uniform distribution in the interval $[0, 1]$. If no information is processed, DM does not decide which good to consume and gets a utility of zero. This would imply that too much information can harm DMs so much that they would not pick anything from the set. This modeling choice tries to capture the fact that in some situations subjects do not make a choice even when they would have been better off choosing randomly than not choosing at all.[1]

At the beginning of the decision process DM takes into account her limitation on processing information and decides how many goods she would like to have in her choice set. Note that if she considers more goods, the expected quality, for any number of bits of processed information, increases. However, the probability of states where little or no information is processed also increases. DM chooses n in order to maximize:

$$\max_{n} U_M(n) = E_\ell \left[\max\{q_0, ..., q_\ell\}\right] \tag{2.1}$$

As long as there is some probability of losing information by increasing the number of objects considered in making a choice, it is optimal to analyze a finite number of goods. The benefit of adding one more good decreases as the size of the set increases. The cost of increasing the size of the set is that the probability of receiving no information increases. As n gets larger, the benefits decrease faster than the costs, and at some point the costs become larger than the benefits.

Theorem 1 *When the amount of information that DM processes is binomial with parameters $(n, \alpha(n))$ with $\alpha(n)$ strictly decreasing, DM chooses the maximum of those n signals, and each signal is uniformly distributed in $[0, 1]$;, there exists an $n^* < \infty$ such that n^* maximizes DM's payoff.*

Proof. Is in Appendix 6.1 ■

[1] The observed behavior in the experiment is consistent with this assumption. Some subjects in some rounds did not make a choice and, as a result, got a payoff of zero.

3 Experimental Design

A good or an object is a column with five numbers, with each number generated from a uniform distribution over the integer numbers {20,...,100}. In order to know the value of a good, subjects have to add the values of the five rows.[2] A game is a matrix with 20 columns and five rows. A choice set is a subset of a game. Each treatment consisted of ten consecutive rounds, and in each round subjects played a different game (an example of the computer interface can be seen in Appendix 6.3).

A round could have either one stage or two stages, depending on the treatment. All subjects, no matter in which treatment they participated, at some stage had to choose a column from a choice set; at this stage they were time constrained, having only 25 seconds to choose a column. The screen showed a clock where they could see how much time was left.

Payoffs in the experiment were denominated in francs. For each treatment there was a conversion rate that subjects were aware of as they begin the treatment. The payoff for each round was the value of their choice multiplied by the conversion rate. All participants were paid what they earned during the experiment plus a show-up fee of $10.

The experimental design included four different treatments. The first treatment, no choice, is used to study whether subjects suffer from information overload. The other three treatments (choice, choice-price [experienced], and choice-price [inexperienced]) are used to analyze the effects of information overload on variety aversion and how it relates to the DM's experience with the task and the task's complexity (Table 3.1 summarizes the characteristics of each treatment). In all treatments subjects completed a survey that recorded some of their personal characteristics.

Table 3.1: Experimental Design

	name	*Choice set*	*Experience*	*Price*
Treatment 1	*no-choice*	given	no	no
Treatment 2	*choice*	choice	no	no
Treatment 3	$choice - price[exp]$	choice	yes	340
Treatment 4	$choice - price[inexp]$	choice	no	340

The experiment took place through computer terminals at the Princeton Laboratory for Experimental Social Science. Participants were students from Princeton University. In each of the treatments 40 students participated. Appendix 6.3 provides an example of

[2]This type of task is also used in Gabaix, et al. (2006).

the computer interface used. The computer program was designed using Multistage game software.

3.1 Information overload

3.1.1 Treatment 1: no choice.

In this treatment, the choice set was assigned to the subjects on each round. As the number of rounds increased, so did the size of the choice set, with increments of two columns per round. On the first round subjects chose a column from a set of 2 columns, and by the last round they chose from a set of 20 columns.[3] In each round subjects had 25 seconds to choose a column. If time ran out before they made a choice, the payoff for that round was zero.

Each subject played each game only once, but the number of columns seen during each game was different depending on which round they were playing. This was done to help the comparison of how the average payoff changed when the number of alternatives changed (Appendix 6.4 shows the algorithm followed to assign a game to each subject). The payoff in each round was the value of a column multiplied by the conversion rate (which, for this treatment, was .002).

Once the treatment was finished, subjects completed a survey where they were asked some questions about the previous treatment and were queried about some of their demographic characteristics (a sample of the survey appears in Appendix 6.6). After completing the survey, subjects were asked to participate in another treatment that served as a pilot for the subsequent treatments.

3.2 Variety aversion

In this set of treatments, I study the preference or aversion for variety of subjects who participated in the experiment. To be able to do this, participants faced a two-stage decision process. In each round participants had to make two choices: first, they had to decide the number of columns they wanted to choose from in the following stage; and then, from that number of columns, they had to select one. In each treatment they played ten rounds, and in each round all players played the same game. No subject played the same game twice.

[3] I did not run a treatment where the size of the choice set decreased from 20 to 2, but considered only the case where the number of columns increased with the number of rounds. If subjects suffer from information overload when complexity of the task is increasing and they can gain experience in each round (increasing order), it can be argued that information overload should be observed when the scenario is more complicated (decreasing order).

3.2.1 Treatment 2: choice.

This treatment is analogous to Treatment 1, the only difference being that the choice set is not given to the subjects. In this treatment, in the first stage of each round subjects had to choose the size of their choice set, and in the second stage they had to choose a column from that choice set. In the second stage subjects were time constrained, having only 25 seconds to choose a column. If time ran out, their payoff for that round was zero. The set of games that was played was the same as in Treatment 1, and the same conversion rate was used (.002). Subjects who participated in Treatment 2 were inexperienced; they had played in no other treatment before, and they had had no previous contact with the experimental setting.

3.2.2 Treatment 3: choice-price[experience].

To increase the complexity of the task subjects are performing, I introduce a price. Now, if subjects are not sufficiently careful, even if they choose the best column available, they might be choosing something that is worth less than the price and therefore have a negative payoff. The price scheme is such that subjects had to pay a price only when they chose a column; there was no (explicit) cost of increasing the size of the choice set before making this choice.

The payoff for each round was computed as the value of the column chosen minus the price they had to pay (340 francs). They had no budget constraint so they could always buy; however, if their total payoff at the end of the tenth round was negative, they earned zero dollars for that treatment. Even if subjects' total payoff was negative, participants had incentives to continue playing: given that they could still buy, they could finish the treatment with a positive payoff as long as they exerted effort and were careful.

If subjects did not make a choice during the 25 seconds, their payoff for that round was zero. The conversion rate for this part was (.0085).[4] The participants in Treatment 3 had played before in Treatment 2, meaning that subjects had experience with the choice setting.

3.2.3 Treatment 4: choice-price[inexperience].

This treatment is exactly the same as Treatment 3, the only difference being that subjects who participated in it had no previous experience; they had not played previously in any other treatment.

[4]With a price, the total possible number of francs that a participant could earn decreases, so I increased the conversion rate.

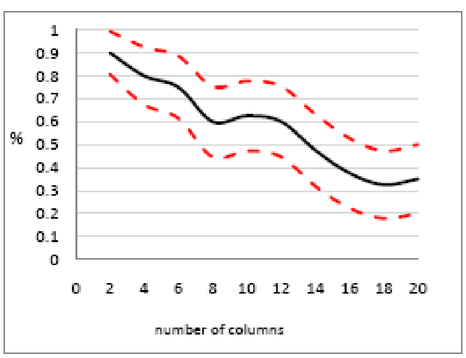
4 Results

4.1 Information Overload

In this section I analyze whether the interface used in the experiment generated information overload in the subjects. It is important to distinguish between the two components of information overload: the first one is that subjects have a limited capacity to process information, and the second one is that they cannot ignore the information they are not able to process; because they are distracted by it, their performance deteriorates.

A simple way to analyze whether subjects have a limited capacity to process information is by studying the percentage of subjects who chose the alternative with the maximum value, as the number of columns increased. Figure 4.1 shows the percentage of subjects who chose the best option available (Table 6.1 in the Appendix shows the exact values). As the number of options increased, the number of subjects who chose correctly declined (Table 6.2 in the Appendix shows the probit with fixed effects; the probability of choosing the best alternative decreases as the number of columns increases). This suggests that, as the number of columns increased, subjects found it harder to process all the information available and therefore to find the column with the maximum value. However, this fact alone does not confirm that subjects suffered from information overload.

Figure 4.1: Percentage of correct responses and Mean Payoff per round.

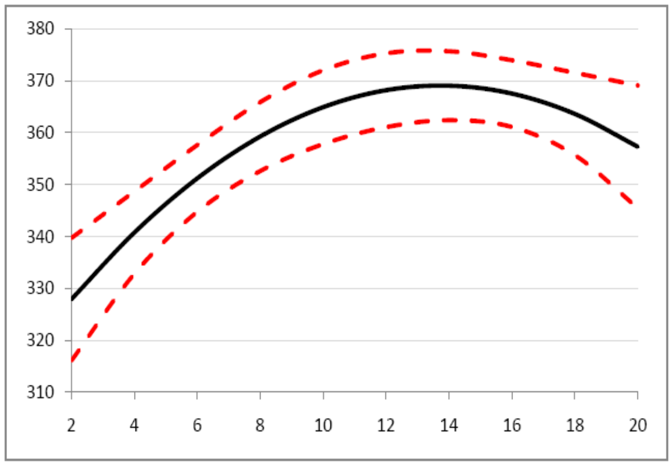


Columns	Mean Payoff
2	324.4
4	339.275
6	359.875
8	358.475
10	366.6
12	367.65
14	360.725
16	370.75
18	361.175
20	360.325

Note: Treatment 1, no choice condition.

Another way of analyzing the limitation on the processing of information is by comparing the average payoff between rounds. The treatment was designed so that the comparison of the average payoff in each round could say something about the performance of subjects (Appendix 6.4 shows the algorithm followed to assign to each subject a game). As can be seen in Figure 4.1 (Table 6.3 in the Appendix shows also the standard errors), the mean payoff when the number of columns was 20 is 360.325, which is smaller than the mean payoff when there were 16 columns (mean 370.75). As the number of columns increases beyond 16, the mean payoff decreases. Under the assumption that subjects have the same ability, the mean payoff per round should not decrease, and the fact that it does suggests that there is information overload. If ability differed among subjects, this would only suggest that there is a limitation on the capacity to process information.

Figure 4.2: Relationship between payoff and the number of columns



To control for the characteristics of the subjects, including ability, and be able to test if subjects suffered from information overload, I ran a quadratic regression with individual fixed effects of the payoff on the number of columns. Table 4.1 shows the predicted number of columns and the 95% confidence interval. Figure 4.2 shows the fitted values for the regression.[5] It can be seen that there is a maximum. The predicted number of columns that maximize the payoff is 13.75 columns, and the biggest possible size of the choice set (20) does not belong to the 95% confidence interval of the argmax. The results suggest that having more than 16 columns or less than 12 makes DMs worse off, and this is consistent with the presence of information overload.

[5]The values are in Table 6.4 in the Appendix.

Table 4.1: Regression of payoff on round and round square.

Dependent variable: *payoff*	(1)
round	14.03^{***}
	(3)
round square	-1.2^{***}
	(.326)
constant	327.8^{***}
	(5.9)
Predicted argmax	13.72832
95% confidence Interval	[11.72936,15.72727]

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
s.e in parenthesis.
Treatment 1: The size of the choice set increased by two columns each round.
The cardinality of the smallest set was 2 (round 1) and of the biggest was 20 (round 10).

Another method I use to study if subjects suffered from information overload was to compute the expected payoff of an individual for participating in the treatment, assuming she would behave according to the behavior distribution of subjects who participated in Treatment 1. I classified each observation according to the following criteria: I assigned the value $k_{c,i} \in \{1, ..., 20\}$, to subject $i's$ choice when there were c columns available, if there were k columns with a value smaller or equal to the value of $i's$ choice. This generates $\{k_{i,c}\}_{i=1}^{40}$ and a distribution k_c over$\{1, ..., 20\}$ for each number of columns c. Note that this is equivalent to saying that an agent $k_{c,i}$, when the size of choice set is c, chooses a fixed number of columns k, and from those columns chooses the maximum.[6]

To compute the expected payoffs for each k_c-level, $E_c\left[p_k\right]$, I use the following rule for $k_{i,c} = c - j$:[7]

$$\begin{cases} E_c\left[p_{c-j}\right] = E\left[y_{c-j,c-j}\right] & \text{if } j \text{ is even} \\ E_c\left[p_{c-j}\right] = E\left[y_{c-j,c-j+1}\right] & \text{if } j \text{ is odd} \end{cases}$$

For every number of columns c there is a vector of expected payoffs $E_c\left[p\right] \in \mathbb{R}^{20}$, with coordinates $E_c\left[p_k\right] = 0$ for $k > c$. It is important to note that, to be able to conclude that subjects suffer from information overload, I construct $E_c\left[p\right]$ so that the coordinates $\left(E_c\left[p_1\right], ..., E_c\left[p_{c-2}\right]\right)$ are the same as $\left(E_{c-2}\left[p_1\right], ..., E_{c-2}\left[p_{c-2}\right]\right)$. By doing this I make sure that in case the pool of subjects that participated in Treatment 1 did not suffer from in-

[6] If a subject is not distracted by the number of columns available (that is, if she did not suffer from information overload), $k_{c,i}$ should not be decreasing in c.

[7] $y_{n,c}, ..., y_{1,c}$ denote the ordered statistics when the value of a column is drawn c times. The maximum is when $n = c$ and the minimum when $n = 1$. The value of a column is distributed according to the distribution of the sum of five numbers, each generated from a uniform distribution over the integers $\{20, ..., 100\}$.

formation overload the expected payoff of participating in the treatment would have been increasing in the number of columns.

I compute the expected payoff of participating in the experiment: $k_c \cdot E_c[p]$ for every possible number of columns available. As can be seen in Table 4.2, if it is assumed that an individual who participates in this experiment will behave according to the behavior distribution k_c generated by the pool of subjects in our sample, it can be concluded that an average participant will maximize her payoff if she chooses from a set with 16 columns rather than from a set with 20 columns.

Table 4.2: Expected payoff of participating in the experiment.

Columns	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*
Expected Payoff	325.3	350.9	364.8	369.5	377.7	383.	377.7	**390.5**	383.9	385.8

Expected payoff taking as given the distribution over the number of columns analyzed by subjects in Treatment 1.

In order to apply the previous methodology to the games that were actually played. I computed the expected payoff of using the $k-$strategy for each realization of the games and every round, assuming the subject picked k columns randomly from the c columns available and from those k chose the maximum. Because I know exactly which game each subject saw in each round, I compared the payoff of the subject in each round with the expected payoff of an agent-k for that particular game and assigned her the value k that described her behavior. If the value of her payoff was between $k = 2$ and $k = 4$, the value $k = 3$ was assigned to that subject in that round. I called this variable "as if" and for every size of the set $\{2, 4, 6, ..., 20\}$ I have a distribution over "as if," behavior.

With each of these distributions I computed the expected payoff of participating in the experiment, assuming that an average subject would behave as the sample did. Taking the distribution of "as if" behavior as given for each number of columns, the expected payoff has a maximum when there are 12 columns (Table 4.3).

Table 4.3: Expected payoff, considering "as if" behavior.

Columns	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*
Expected Payoff	331.2	349.6	363.8	370.8	372.1	**384.4**	371.3	375.2	374.5	373.9

Expected payoff taking as given the "as if" behavior distribution generated by subjects in Treatment 1.

The previous findings (Table 4.2 and Table 4.3) suggest that subjects not only are not able to process all the information available but also are "distracted" by it. As the number of columns available increases, their performance starts to deteriorate, which is consistent with information overload.

At the end of the experiment, when subjects were asked whether they were distracted by the presence of too many columns, 85% answered positively. They were also asked how many columns they would like to choose from, and the average number of columns selected was 6.0975, the median and mode were 5 columns. Twenty subjects answered that they would prefer to choose from a set with 20 columns.

From Treatment 1 we may conclude that subjects suffered from information overload. The more columns there were, subjects were, on average, able to analyze fewer columns. Subjects were not able to focus on a specific number of columns; they were "distracted" and therefore made worse choices when more options were available. Moreover, the results suggest that the optimum number of columns lies between 12 and 16.

4.2 Variety Aversion: Choosing the Size of the Choice Set

The only difference between Treatment 2 (choice) and Treatment 1 (no choice) is that in Treatment 2 each round has two stages. In the first stage, at the beginning of each round subjects could choose how many columns they wanted to choose from in the next stage of that round. The conversion rate, number of rounds, and time constraint were the same in all cases.

At the beginning of each round subjects could choose an even number (from 2 to 20) of columns to see in the next screen. Once they clicked “submit,” the chosen number of columns appeared on the screen and they could choose a column from that set. An example of the computer interface can be seen in Appendix 6.3.

Table 4.4 shows the mean size of the set chosen per round in Treatment 2. The values of the means belong to the interval [10.65,12.4]; the maximum was 12.4 in round 5. The average number of columns chosen among all rounds was 11.425, and the median was 10. In the ten rounds, 40% of subjects chose 20 columns at least once. Of these, 17.5 % chose 20 always and 20% continued choosing 20 after they chose it for the first time (the frequency table is in the Appendix in Table 6.5).

Table 4.4: Mean number of columns chosen by round.

Columns	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Total*
mean columns chosen	10.65 (.9)	11.35 (.9)	11.15 (.9)	11.65 (.9)	12.4 (.9)	10.9 (1)	10.95 (1)	11.45 (.9)	10.51 (.8)	12.25 (1)	11.42 (.3)

Note: data from Treatment 2. Subjects choice of the size of their choice set; s.e in parenthesis.

4.2.1 Do subjects behave differently?

Standard economic theory would predict that subjects would not behave differently whether the choice condition was given to them or they chose it themselves. Once the subject faces a choice set, she should maximize her consumption value. To see if subjects behaved differently in this experiment, I compared the choice (T2) and no choice (T1) treatments with regard to the "as if" behavior, the percentage of participants choosing the best alternative, and the average time spent per column.[8]

Table 4.5 suggests that the best behavior in both cases is observed when there are 12 columns. Note that in the no-choice treatment there are 40 observations for each number of columns. However, for the choice treatment the number of observations is not the same for each number of columns, because people are choosing how many columns they want to see. The last column of the table suggests there is some self-selection effect: subjects who chose 20 columns (choice) did better than the mean payoff when all subjects had to pick from 20 columns. However, even if there is some self-selection, subjects who chose more than 12 are not, on average, doing any better than those who chose 12 in (T2).[9]

[8] "As if" behavior is a variable constructed in the following way: I compared the payoff of the subject in each round with the expected payoff of an agent-k for the particular game she was playing and assigned her the value k that described her behavior. An agent-k assumes the subject picked k columns randomly from the c columns available and from those k chose the maximum.

[9] We can see that 20 columns were chosen 96 times; however, only 7 subjects always chose 20 columns.

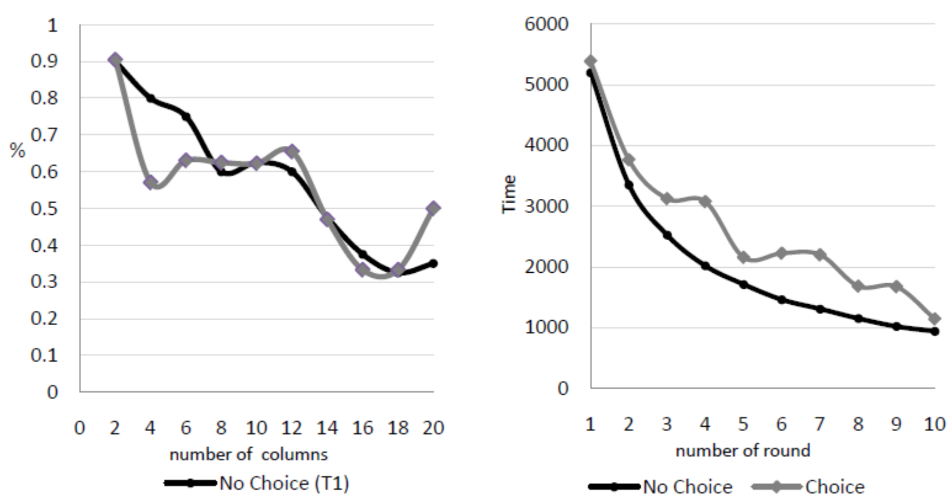
Table 4.5: Comparison of the expected payoff taking as given the "as if" behavior.

Columns	*2*	*4*	*6*	*8*	*10*	*12*	*14*	*16*	*18*	*20*
no choice (T1)	331.2	349.6	363.8	370.8	372.1	384.4	371.3	375.2	374.5	373.9
choice(T2)	328.3	334.7	349.6	345.9	371.1	384.2	369.2	364.8	371.1	379.5
number of observations	21	28	65	56	61	29	17	12	15	96

Expected payoff taking as given the distribution over the "as if" behavior. Note: the number of observations is always 40 for Treatment 1.

Another important fact is that the percentage of subjects who chose the best alternative in both treatments, for the same number of columns, is not different (Figure 4.3, exact values are in Table 6.1 in the Appendix). This suggests that subjects process the same information whether they choose the number of columns or are given to them.

Figure 4.3: Percentage of correct choices and Mean time spent per column



Percentage of correct choices

Mean time spent per column in each round

Note: Time is measured in milliseconds.

One difference observed in the subjects' behavior is that those who chose the size of the set spent more time per column than those who did not.[10] The difference in mean time per column is significant starting from the fourth round; this can be seen in Figure 4.3 (exact

[10] Time is measured in milliseconds; 1 second is 1,000 milliseconds.

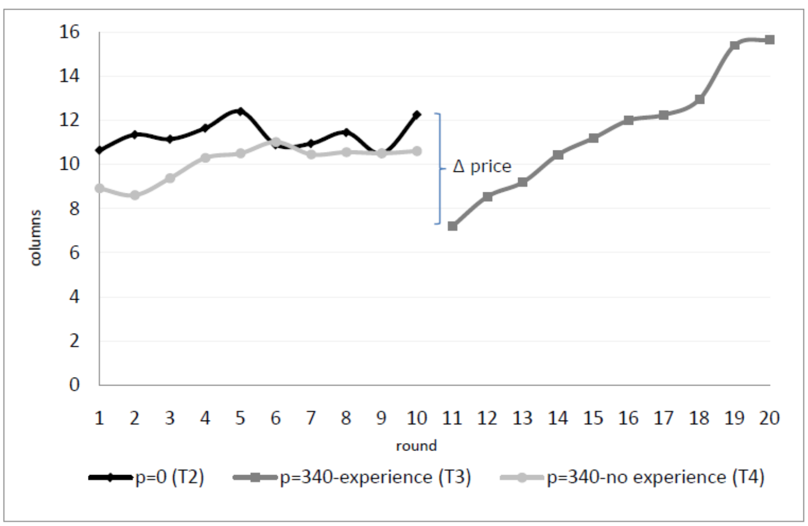
values are in Table 6.6 in the Appendix). This suggests that having control over the number of options makes people pay more attention.

4.2.2 The effects of increasing the complexity of the task and experience

To increase the complexity of the task, I ran some treatments (choice-price[exp] (T3) and choice-price[inexp] (T4)) where subjects had to pay a price each time they chose a column from their choice set. There was no cost to increasing the size of the choice set, and if subjects let the time run out without choosing a column, they would pay zero and earn zero francs. The price they had to pay was 340 francs, which is greater than the expected value of a column (300 francs). Whenever subjects chose a column, the payoff for that round was the value of the column chosen minus the price (340 Francs) multiplied by the conversion rate (.0085).

The main difference between the choice-price[exp] and choice-price[inexp] treatments is that in choice-price[exp], subjects were experienced. The pool of subjects that participated in Treatment 3, choice-price[exp], is the same pool of subjects that participated in Treatment 2 (choice), where the price was zero.

Figure 4.4: Mean Size of the Choice Set



Note: the graph represents the mean number of columns chosen, for each of the treatments.
T2: price is zero and subjects are inexperienced.
T3: participants in this treatment are the same that participated in T2, so they are experienced, and had to pay a price of 340 Francs each time they picked a column from the choice set they chose on the previous stage.
T4: participants are inexperienced and had to pay a price of 340 Francs each time they picked a column.
The expected value of a column is 300 Francs.

The effect of adding a price can be analyzed by comparing Treatment 4, choice-price[inexp], with Treatment 2, choice no price, and Treatment 3, choice-price[exp], with Treatment 2, choice no price. As can be seen in Figure 4.4 (exact values are in Table 6.7 in the Appendix), when subjects had no previous experience, they preferred smaller sets when they had to pay a price (choice-price[inexp]) than when the price was zero (choice), Table 4.9.[11] Even though differences are not significant, for almost all the rounds the set is almost always smaller when they had to pay a price.

Table 4.6: Comparison: mean size of the choice set for inexperienced subjects with price=340 and price=0.

Round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*over all*
mean (T2)-mean(T4)	1.73	2.74**	1.77	1.35	1.89	−0.12	0.49	0.89	0	1.64	1.33***

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
T2: inexperienced subjects and price=0
T3: experienced subjects and price=340

If Treatments 2 and 3 are compared (price=0; and price=340, with experience), as in Table 4.7, we see that experienced subjects reduced considerably the size of the set the first time they faced a price. Remember that participants in these two treatments are the same. The difference between the mean size of the choice set of the last round of price=0 (10th round) and the first round (11th round) of price=340 [exp] is a decrease of 5.05 columns. In addition, the difference between the first round and the 11th is significant. This suggests that as the complexity of the task increases, so does the aversion for variety.

Table 4.7: Comparison: behavior of participants when a price is introduced.

Round	*10-11*	*1-11*
mean (T2)-mean(T3)	5.05***	3.45**

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
column 1: difference the last round of T2 with no price and the first with p=340
column 2: difference between the first round of each treatment

[11]Bartlett's tests were run comparing all treatments: 2, 3, and 4. It cannot be rejected that they have equal variances so we can compare the means.

Table 4.8: Comparison: mean size of the choice set for subjects that face a price=340 and are experienced (T3) or inexperienced (T4).

Round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*over all*
mean (T3)-mean(T4)	-1.72	-0.06	-0.18	10.15	0.69	0.98	1.79	2.39*	4.89***	5.04***	1.395***

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.

Another interesting question is how variety aversion is affected by experience. If I compare two equal situations (both of them had the same price), with the only difference being whether subjects were familiar with the game or not (in Treatment 3 subjects had played before in the situation with no price), we see that the size of the set increases as experience increases. Table 4.8 shows that during the first three rounds experienced subjects chose a smaller set, but as they play more rounds, they increase the size of the set and continue to do so. In the last three rounds the size of the set selected by experienced subjects was significantly larger than the set selected by inexperienced ones. Experience helps to improve ability and hence they are able to handle larger sets.

Table 4.9: Comparison: mean size of the choice set for inexperienced subjects with price=340 and price=0.

Round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*over all*
mean (T2)-mean(T4)	1.73	2.74**	1.77	1.35	1.89	−0.12	0.49	0.89	0	1.64	1.33***

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
T2: inexperienced subjects and price=0
T3: experienced subjects and price=340

Another important way of comparing the effects of complexity and experience is through the payoffs (Table 4.10). To be able to compare the treatments, I take the value of the column chosen rather than the value minus the price.

We see that experience has a very strong effect. Treatment 3 (choice-price[exp]) got the highest payoff, one that was significantly higher than Treatment 4 (choice-price[inexp]). This reflects the fact that in the last rounds of choice-price[exp] subjects chose larger sets (note that they never surpass 16, which is the upper bound of the optimal number of columns). On the other hand, the effect of complexity alone (choice and choice-price[inexp]) is negative. When there is a price and subjects have no experience, they choose smaller sets and the increased complexity makes their performance deteriorate.

Table 4.10: Mean payoff comparison in Francs.

Treatment	*payoff*		*difference*
Price=0 *choice* (*T*2)	3580.475	*T2-T3*	-68.3
Price=340 *choice* (*T*4) *no experience*	3648.775	*T2-T4*	75.68^{***}
Price=340 *choice* (*T*3) experience	3504.795	*T3-T4*	143.98^{**}

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.

4.2.3 Do subjects choose optimally?

The evidence presented in section 4.1 suggests that the optimal number of columns is smaller than 20 and lies between 12 and 16. The mean number of columns chosen when subjects are inexperienced and do not face a price (Table 4.4) is not significantly different from 12 but is always statistically different from 14 and 16.[12] This suggests that subjects' choice lies in the lower bound of the optimal interval.

On the other hand, when subjects are experienced (choice-price[exp]), even if they face a price, the mean size of the choice set belongs to the optimal interval for the last six rounds [12,16] (Table 4.8). It can be seen that for the last two rounds the mean is not different from 16. It should be noted that the optimal interval was obtained from nonexperienced subjects. However, as the theory would predict, the optimal number of options should increase with experience, and this is observed in the data.

[12] It is either 1% or 5% significantly different from 14 in rounds 1, 2, 3, 4, 5, 6, 7, 8, and 9; round 10 has a 10% significance level. For all rounds it is 1% significantly different from 16.

5 Conclusions

This paper analyzes the effect that information overload has on preference or aversion for variety. According to the model a rational DM who suffers from information overload, faces a two-stage decision process, and is choosing from a set of unknown goods will use variety aversion as a strategy to deal with her cognitive limitation. There is an optimum number of alternatives DMs would like to consider before making a choice. An experiment is conducted in order to test this hypothesis.

First, the experimental evidence confirms that the experimental design and interface used generated information overload in the subjects, which follows the main assumption of the model. Second, it also confirms that subjects reduce the size of their choice set to deal with this problem. Moreover, from the results of Treatment 1 (no choice), where a negative effect of too much information can be seen, the data suggests that in this setting the optimal number of options lay between 12 and 16 columns. In addition, the average choices made by subjects in Treatment 2, where they could choose the size of their choice set, are not different from 12 but are different from 14 and 16. This suggests that subjects are choosing in the lower bound of the optimal range.

With an increase in the complexity of the cognitive process that subjects must perform to find out the value of a good that is worth consuming, subjects reveal a preference for smaller sets. Variety aversion increases when subjects who are familiar with the game face a price for the first time. The method used in this experiment to increase complexity (introducing a price) suggests that more expensive objects will require more attention and therefore subjects would be better off choosing them from smaller sets.

Subjects' behavior shows that experience plays a very important role in determining the size of the choice set selected. As experience increases, subjects want to analyze more alternatives, and the size of the choice set increases.

This paper helps to understand better the cognitive process subjects follow when choosing from a set of unknown goods. The results in this paper establish a link between a cognitive limitation, information overload, and preference or aversion for variety. In this framework, variety aversion results from the maximization of expected utility subject to the inability to process information. Experimental results are consistent with the model and show that subjects behave strategically about their bounded capacity.

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6 Appendix

6.1 Proof of Theorem 1

Proof. Recall that DM objective is to maximize

$$U_M(n) = \sum_{\ell=0}^{n} \binom{n}{\ell} \alpha(n)^{\ell} (1-\alpha(n))^{n-\ell} \frac{\ell}{\ell+1}$$

The strategy of the proof is to find a function $f : (0, \infty) \to (0, \infty)$ such that $U_M(n) < f(n)$ for n suficiently large, and such that $\lim_{x\to\infty} f(x) = 0$. This would imply that $\lim_{n\to\infty} U_M(n) = 0$.

Let

$$f(x) = \left(1 - (1-\beta(x))^{x-\ell}\right) \frac{x}{x+1}$$

where $\beta : (0, \infty) \to [0, 1]$ is any strictly decreasing function such that $\alpha(n) = \beta(n)$ if $n \in \mathbb{N}$. We argue that $U_M(n) < f(n)$.

To see this notice that $U_M(n)$ can be written as

$U_M(n) = \left(0, \frac{1}{2}, ..., \frac{n}{n+1}\right) \cdot (p(\ell = 0), p(\ell = 1), ..., p(\ell = n))$

where $p(\ell = k) = \binom{n}{k} \alpha(n)^k (1-\alpha(n))^{n-k}$. Similarily,

$f(n) = \left(0, \frac{1}{2}, ..., \frac{n}{n+1}\right) \cdot \left(p(\ell = 0), 0, ..., 0, \sum_{i=1}^{n} p(\ell = i)\right)$.

To see that the inequality holds, one only needs to notice that $\frac{1}{2}p(\ell = 1) < \frac{n}{n+1}p(\ell = 1)$, $\frac{2}{3}p(\ell = 2) < \frac{n}{n+1}p(\ell = 2)$ and so on.

Finally, since $\lim_{x\to\infty} f(x) = 0$ there must exist an $\overline{n}$ such that $f(n) < \frac{\alpha(1)}{2}$. for all $n > \overline{n}$. Since there are only finitely many numbers between 1 and $\overline{n}$, a maximal n^* must exist. ■

6.2 Tables

Table 6.1: Percentage of subjects choosing the correct alternative.

columns	*frequency No Choice*	*frequency Choice*	*columns*	*frequency No Choice*	*frequency Choice*
2	.9	0.905	*12*	.6	0.655
	(0.05)	(0.06)		(0.08)	(0.09)
4	.8	0.571	*14*	.475	0.47
	(0.06)	(0.12)		(0.08)	(0.09)
6	.75	0.631	*16*	.375	0.333
	(0.07)	(0.06)		(0.08)	(0.1)
8	.6	0.625	*18*	.325	0.333
	(0.08)	(0.07)		(0.07)	(0.05)
10	.625	0.623	*20*	.35	0.5
	(0.08)	(0.06)		(0.08)	(0.05)

Table 6.2: Probit.

	Choosing the best alternative
round	$-.1930504^{***}$
	(.025689)
constant	1.119608^{***}
	(.1570809)

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
s.e in parenthesis

Table 6.3: Mean Payoff.

columns	*mean payoff*	st.errors	*columns*	*mean payoff*	st.errors
2	324.4	7.135214	*12*	367.65	4.929705
4	339.275	6.929127	*14*	360.725	10.42199
6	359.875	5.966156	*16*	370.75	4.935579
8	358.475	5.707618	*18*	361.175	9.994735
10	366.6	5.523818	*20*	360.325	10.74562

Table 6.4: Payoff fitted values by column.

columns	*payoff*	st.errors	*columns*	*payoff*	st.errors
2	327.868	5.907204	*12*	368.1327	3.55781
4	340.7084	3.966987	*14*	**369.0044**	3.321595
6	351.1551	3.216952	*16*	367.4824	3.216952
8	359.2081	3.321595	*18*	363.5666	3.966987
10	364.8673	3.55781	*20*	357.257	5.907204

Table 6.5: Frequency of 20 being choosen

number of times 20 was choosen	*0*	1	2	3	6	7	10
number of subjects	23	5	1	2	1	1	7

Table 6.6: Mean time per column per round

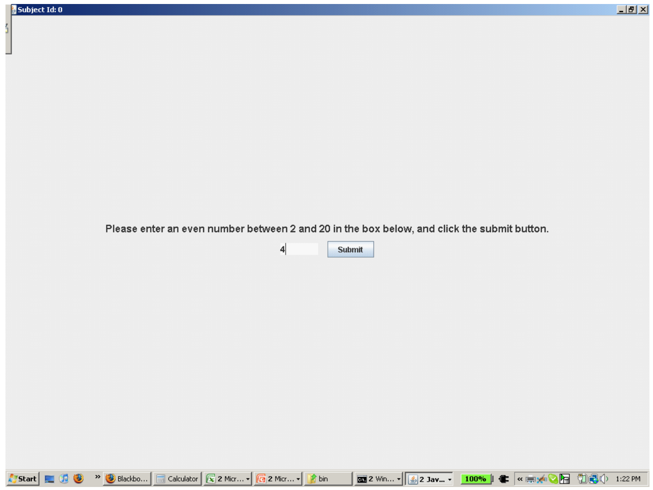
Round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
no choice(T1)	5200.4 (384.9)	3353.3 (233.5)	2524.8 (137.2)	2017.7 (103)	1712.5 (80.5)	1460.7 (70.6)	1308 (45)	1150.2 (41.2)	1018.8 (40.2)	939.2 (33.4)
Price=0 choice $(T2)$	5388.5 (667.8)	3765.4 (427.5)	3124.7 (357.8)	3075.7 (459.7)	2158.7 (207.2)	2227 (346.7)	2201.1 (215.4)	1684.5 (227)	1676.5 (327.4)	1145 (96)
$(T2) - (T1)$	188.1	412.1	599.9	1058.0*	446.2*	766.3*	893.1***	534.3**	657.7*	205.8*

***,**,*, indicate significance at the 1, 5, and 10 percent, respectively.
Time is measured in milliseconds

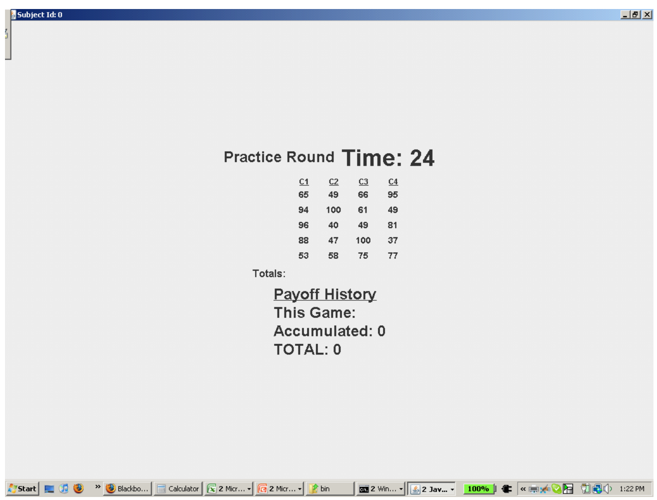
Table 6.7: Mean size of the choice set.

Round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*over all*
Price=0 choice (*T*2)	10.65 (.9)	11.35 (.9)	11.15 (.9)	11.65 (.9)	12.4 (.9)	10.9 (1)	10.95 (1)	11.45 (.9)	10.51 (.8)	12.25 (1)	11.42 (.3)
Price=340 choice (*T*4) *no experience*	8.92 (.7)	8.61 (.7)	9.38 (.9)	10.3 (1)	10.51 (.9)	11.02 (.9)	10.46 (.8)	10.56 (.8)	10.51 (.8)	10.61 (.9)	10.09 (.3)
Price=340 choice (*T*3) experience	7.2 (1)	8.55 (1)	9.2 (1)	10.45 (1)	11.2 (1)	12 (.9)	12.25 (.9)	12.95 (.8)	15.4 (.8)	15.65 (.9)	11.485 (.3)

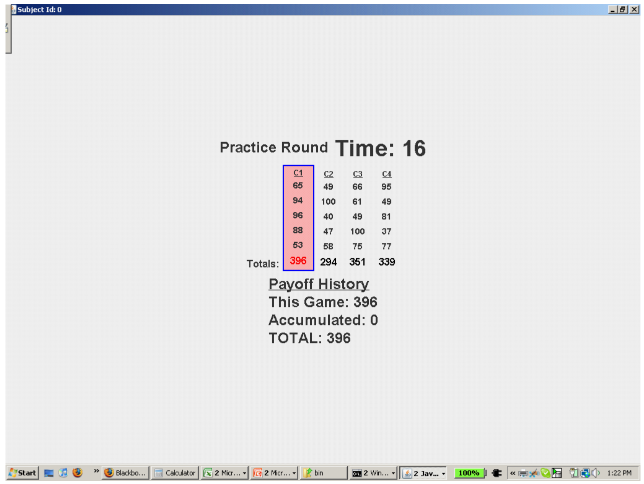
6.3 Computer interface



First Screen



Second Screen



Third Screen

6.4 Assignment of Games for Experiment 1

A game has 20 columns. Each column has 5 rows. The numbers in each column are generated from a discrete uniform distribution on the interval [20,100].

N is the number of subjects. N different games are generated at the beginning of the experiment. There are 10 rounds. Each round has 2,4,6,8,10,12,14,16,18, or 20 columns. In round 1 subjects see only 1 column; in round 2, 2 columns; etc.

Lets denote $G_{k,r}$ the kth game generated that appears in round r, so only the first r columns of the game appear on the screen.

Each round each subject will play the following sequence of games:

Subject\round	**1**	**2**	**3**	**...**	**8**	**9**	**10**
1	$G_{1,1}$	$G_{N,2}$	$G_{n-1,3}$	...	$G_{N-6,8}$	$G_{N-7,9}$	$G_{N-8,10}$
2	$G_{2,1}$	$G_{1,2}$	$G_{N,3}$	...	$G_{N-5,8}$	$G_{N-6,9}$	$G_{N-7,10}$
3	$G_{3,1}$	$G_{2,2}$	$G_{1,3}$	...	$G_{N-4,8}$	$G_{N-5,9}$	$G_{N-6,10}$
...				...			
N-2	$G_{N-2,1}$	$G_{N-3,2}$	$G_{N-4,3}$	...	$G_{1,8}$	$G_{N,9}$	$G_{N-1,10}$
N-1	$G_{N-1,1}$	$G_{N-2,2}$	$G_{N-3,3}$	...	$G_{2,8}$	$G_{1,9}$	$G_{N,10}$
N	$G_{N,1}$	$G_{N-1,2}$	$G_{N-2,3}$	...	$G_{N-7,8}$	$G_{N-8,9}$	$G_{N-9,10}$

6.5 (Not for publication) Instructions

Thank you for agreeing to participate in this experiment. This is an experiment in decision making. During the experiment we require your complete, undistracted attention and ask that you follow instructions carefully. Please turn off your cell phones. Do not open other applications on your computer, chat with other students, or engage in other distracting activities. You will be paid for your participation in cash, at the end of the experiment. Different participants may earn different amounts. What you earn depends on your decisions. The entire experiment will take place through computer terminals. It is important that you not talk or in any way try to communicate with other participants during the experiments.

We will start with a brief instruction period. During the instruction period, you will be given a complete description of the experiment and will be shown how to use the computers. If you have any questions during the instruction period, please raise your hand and your question will be answered out loud so everyone can hear. If you have any questions after the experiment has begun, raise your hand, and an experimenter will come and assist you. After the Instructions, there will be a practice session. You will not be paid for the match in the practice session. The practice session will be followed by the paid session. At the end of the paid session, you will be paid the sum of what you have earned, plus a show-up fee of $10.00. Everyone will be paid in private and you are under no obligation to tell others how much you earned. Your earnings during the experiment are denominated in francs for this experiment the value of a franc varies en each part of the experiment. The computer keeps a record of the payments.

In this experiment there will be 3 parts. Before each part begins the instructions corresponding to that part will be given to you.

First Part:

In this experiment there will be 10 rounds. In each round you will be choosing an object from a set.

Each round has two stages. In the first stage you will have to choose the number of objects you want to choose from. You can choose an even number from 2 to 20. In the second stage you can choose an object.

[Screen 1]

An object is a list of 5 numbers. Each of these five numbers can take a value from 20 to 100 with equal probability.

[Screen 2]

The value of an object is the sum of the 5 numbers.

In the second stage you will have to choose a column from the number of columns you chose before. You will have 25 seconds to choose a column, your payoff of choosing a column is the value of the column times the conversion rate. The exchange rate for this part is .002, this means that if you earn 3000 francs you earn 6 dollars. The computer will keep record of your payoffs.

If you don't make a choice before time runs out your payoff for that round will be zero. Once you make a choice the payoff that you earn on that round will appear on the screen.

[Screen 3]

The first screen of the experiment on your computer should look similar to this screen. [POINT TO PPT SLIDE DISPLAYED ON SCREEN IN FRONT OF ROOM] Please note that the screen exhibited up front is not necessarily the same as any of the screen exhibited on your computer. All the slides we display in front are just to illustrate and are not supposed to be suggestive in any way.

Once you select an even number from 2 to 20 and click submit the following screen that you will see will look like this

[Screen 4]

On the upper right of your screen there is a clock that shows the remaining time you have to make your decision

On the lower part of the screen you will see the payoff history: First you will see your payoff for this round, the accumulated payoff in the game, and your total payoff.

[Screen 5]

Once you click in a column it will be selected and the value of all the objects will appear in the screen. Note that the maximum value will be highlighted in red. Also, note that your payoff for that round appears and is added to the accumulated payoff in the total payoff.

This information will appear on your screen for 5 seconds before continuing.

[Screen 6]

After each round you will have to click to proceed to the next round.

We will now begin the Practice round. During the practice round, please select a column and then click on the proceed button. Remember, you are not paid for this practice round.

[AUTHENTICATE CLIENTS]

Please double click on the tree icon on your desktop that says info. When the computer prompts you for your name, type your First and Last name. Then click SUBMIT and wait for further instructions.

[START GAME]

Please answer the practice session

We are ready to start. We will now begin with the 10 paid rounds. Please pull out your dividers for the paid session of the experiment. If there are any problems or questions from this point on, raise your hand and an experimenter will come and assist you.

Once the objects appear on the screen, please select a column, and then click on the proceed button.

Are there any questions before we begin with the paid session?

Start...

This completes the first part of the experiment.

Second Part:

[Screen 7]

In this part of the experiment before each round, you will have to choose how many columns you want to see in the following screen. Once you select an even number from 2 to 20 and click submit you will see a screen with the number of columns you selected.

[Screen 8]

Each time you select a column you have to pay a price of $340 francs. If you don't select a column you pay $0 francs.

[Screen]

What you earn at the end of part 3 will be determined by the following rule: total payoff times the conversion rate of .0085

Or zero if your total payoff at the end of the 10th round is less than 0 francs.

For example...

[Screen 9]

Are there any questions?

We will go now through a practice session. You won't be paid for the practice session.

Please double click on the icon on your desktop that says info. When the computer prompts you for your name, type your First and Last name. Then click SUBMIT and wait for further instructions.

Please answer the practice session

This is the end of the practice session. Are there any questions before we start the paid rounds?

Please start...

This marks the end the experiment.

Third Part:

In the third part of the experiment you are asked to fill out a survey.

Now please double click on the icon on your desktop that says survey. When the computer prompts you for your name, type your first and last name. Then click submit and wait for further instructions.

Please now answer the survey.

[Screen 10]

Your total payoff is your payoff from the first and second parts of the experiment plus the show-up fee of \$10. We will pay each of you in private in the next room in the order of your arrival.

Please make sure you have filled out the voucher sheet and sign it and turn it when you receive payment. You are under no obligation to reveal your earnings to the other players.

This completes the experiment. We will pay each of you in private in the next room in the order of your Subject ID numbers. You are under no obligation to reveal your earnings to the other participants. Thank you for your participation.

6.6 (Not for publication) Survey Questions

Please answer the following questions as honestly as possible. Use the scroll bar on the right to scroll down.

What is your age?

What is your name?

What is your major?

What is your ethnicity?

0=Caucasian

1=African American

2=Asian

3=Hispanic

4=Native American / Native Hawaiian / Native Eskimo

5=Pacific Islander

Other (please specify)

What is your gender?

0=Male

1=Female

What class year are you?

0=Freshman

1=Sophomore

2=Junior

3=Senior

4=Graduate Student

5=Other (please specify)

Have you ever taken an economics class?

0=Yes

1=No

How would you classify your arithmetic abilities?

0=Very Good

1=Good

2=Fair

3=Bad

4=Very Bad

Please answer the remaining questions carefully.

Do you think having too many columns to choose from is distracting?

0=Yes

1=No

If you could choose the number of columns before each round, what number would be your choice?(number from 1 to 20)

Did you ever chose randomly?

0=Yes

1=No

What kind of strategy you used when the number of columns was small?

0=Adding numbers

1=Comparison among columns

2=Random Choice

3=Other (please specify)

What kind of strategy you used when the number of columns was big?

0=Adding numbers

1=Comparison among columns

2=Random Choice

3=Other (please specify)