Framing Effects and Consumer Behavior in the Cell Phone Market: An Experiment

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Contents

1 Introduction

Over the past few decades mobile phone devices have become undeniably essential to the global economy. With more than 4.6 billion subscriptions worldwide, much of the world's communication now depends on mobile phones (Heeks 2008). The rapid evolution of the cell phone, from a telecommunication device to a personal organizer and computer, has broadened its functionality to the point where much of the world's economic infrastructure now depends on it. It is evident from the significance of mobile devices in today's economy that understanding the dynamic relationship between cell phone providers and consumers is essential to understanding the mechanics of our economy.

This paper attempts to explain some of the consumer behavior that appears in cell phone markets. Economists and market researchers have been vexed by counter-intuitive behavior in this market for some time. It is posited that traditional tools of behavioral economics such as rational expectations and expected utility theory may fall short in modeling consumer behavior and predicting preferences. Furthermore it is suggested that an alternative theory-prospect theory- can help resolve some of the inconsistencies that come up with the classical decision theory framework. We will use some of the theoretical and empirical results of prospect theory to test hypotheses on consumer preferences in the cell phone market by means of a randomized survey experiment.

If the results of this experiment confirm the psychological biases predicted by prospect theory (which I shall describe shortly) then this paper will give some motivation for further research in this area for cell phone markets. More than just contributing research in support of prospect theory, however, I hope this paper will show how counter-intuitive models for describing human behavior under uncertainty can give deep insights into the inner-workings of important markets in the economy.

This paper is arranged in the following manner: Part 2 will briefly describe some of the behavior that has been observed in cell phone markets and the inconsistencies this behavior presents to the theory of rational consumer choice. Part 3 will go over some of the key findings of prospect theory as well as suggest how it may serve as an alternative to rational consumer choice. In Part 4, I will describe the methodology of the experiment which will test my hypotheses. In Part 5, I will describe the actual experiment in more detail as well as analyze its results. Finally, Part 6

will be the conclusion of the paper.

2 Behavior

In unison with the improvements of cell phone and satellite technology over the last decade, the products and services offered by mobile phone providers have become increasingly complex. This has led to increasing confusion among consumers and, as a result, discontent. As an illustration of this, the Better Business Bureau ranked cellular phone service and equipment number two in its top ten consumer complaint categories in 2010 (BBB 2010). The category has made the list for many of the past years. While poor customer service and product underperformance surly accounts for some of this anger, it stands to reason that the complexity of cell phone plans, whether made intentionally or unintentionally by providers can cause perception errors and miscalculations by consumers. It stands to reason that after a plan is purchased, if expectations and reality do not match, surprise and regret may result. Furthermore, as was mentioned earlier, it has been observed by economists and market researchers alike that consumers in the cell phone market exhibit preferences that run contrary to fundamental economic assumptions (see Hansell, 2009). In particular, the notion that consumers obey the laws of expected utility theory seems to be at odds with reality. As an illustration, here are some examples borrowed from a New York Times article on the peculiarities of the cell phone market:

- When a major cell phone provider started offering its brand new smart phone for $199, plus $30 a month for internet access, sales shot up, even though the previous deal — $399 for the phone and $20 a month — cost less over a two-year contract.
- When companies introduce certain discounts — like free calling to any mobile number — the effect is that customers often switch to more expensive plans.
- Consumers tend to prefer packaged plans that offer a big block of minutes, texts, etc. for a fixed monthly price rather than plans that are priced more variably according to usage amount.

Let us examine why the preferences described by these anecdotes seem at odds with what

economic intuition might predict.

A rational consumer tries to maximize benefit while minimizing costs. Therefore, in the first example where a consumer is faced with the decision between the pairing of a high phone price with low monthly service costs- which we can call plan A- and the pairing of a low phone price with high monthly service costs-which we can call plan B- we would expect the consumer to prefer which ever plan is cheaper (since the products are identical). In terms of total dollar costs, the first plan costs $40 less than the second plan over two years. However, because the costs of both plans are distributed over a span of time a rational consumer will take the time value of the monthly payments into consideration. In other words a rational consumer discounts monthly component of the total plan cost at some rate which she perceives as a rate of return from alternative investments. Using a simple present value calculation, we must solve the following inequality for *r*:

$$PV_A \leq PV_B$$

Or

$$\left(\$199 + \sum_{n=0}^{23} \frac{\$30}{(1+r)^n}\right) \leq \left(\$399 + \sum_{n=0}^{23} \frac{\$20}{(1+r)^n}\right)$$

The higher the discount rate *r* the more attractive plan A becomes as the monthly component of the cost becomes smaller. The implicit monthly discount rate that satisfies this inequality is greater than 1.7%. This implies a 21.7% annual effective rate of return- quite a high figure considering that the average return on the stock market in the last twenty was around 6.23% (S&P). This high discount rate shows that consumers perceive costs in the future as smaller than they actually are.

The second example can be viewed in the following manner. Assume that a consumer is faced with two plans: A and B. Assume A is cheaper than B. We can argue that the values of these plans to any rational consumer can be described by strictly decreasing functions of price. If we let price$=x$, we can let $A(x)$ and $B(x)$ be the functions representing the value of A and B, respectively. We can make this assumption since, *ceteris paribus*, consumers prefer lower prices to higher prices.

According to utility theory, if a consumer prefers plan A to B then $u(A) > u(B)$ where u is

the consumer utility function which may or may not be linear. Assuming that the current price of A is x if a new plan $C = A(x - z)$ comes along that gives everything that plan A does but for a discount of z we expect to see $u(C) > u(A)$ since the decreased price increases the value of the plan. By transitivity of preferences this should imply $u(C) > u(B)$. Instead we observe that $u(C) < u(B)$. This violation of a central axiom of utility theory can only be explained by external psychological factors that are not accounted for in utility theory and implies that consumers perhaps overweigh a small gain from savings.

The third example is perhaps the strongest indicator of how preferences in cell phone markets violate classical economic intuition. Telecommunication researcher Roger Entner observed that people tend to overbuy minutes in the form of packages because of relatively high overage charges by cell phone companies (Hansell, 2009). This phenomena can be attributed to risk aversion but it should be noted that classical rational choice theory assumes perfect information- and since consumers control the monthly usage of their phone we would expect that plans priced to directly reflect usage quantity would be preferred. Therefore, there are some other characteristics of a consumers' valuation of potential losses that need to be taken into account.

I shall try to argue in the rest of this paper that monthly usage is characterized by uncertainty and that framing effects used to cope with uncertainty lead to different results than we would expect from classical decision theory. A close analogy, which I believe is useful in understanding consumer behavior in the cell phone market, is the insurance market. We see that in both markets a consumers is faced with uncertainty about future events and assesses the probability of a loss distribution for each risky event. If we use some of the tools and models created to understand consumer behavior under these conditions we can perhaps gain more insight into consumer behavior in the cell phone market. This leads to our discussion of prospect theory.

3 Consumer Behavior and Prospect Theory

3.1 Prospect Theory

In 1979, Daniel Kahneman and Amos Tversky published a radical paper challenging the empirical validity of expected utility theory in the analysis of certain classes of choice problems. The paper was called *Prospect Theory: An Analysis of Decision under Risk* and in it the axioms of expected utility theory are shown to be inadequate for a descriptive model of actual behavior under risk.

Kahneman and Tversky develop an alternative: prospect theory. Like classical decision theory, prospect theory attempts to understand human behavior through formal models. Where it differs from classical decision theory, and many argue improve upon it, is in its use of experimental results and its incorporation of ideas from both economics and psychology to formulate its models. Though the theory has gone through many developments since its inception, its core assumptions remain well grounded and shall be the ones utilized in this paper.

First, a prospect is any collection of payoffs that have probabilities associated to them. We can write any prospect with two potential payoffs as $(x, p; y, 1-p)$, where the prospect pays x with probability p and pays y with probability $1-p$. Therefore a gamble in which a person can win \$1 with probability .5 and win nothing with probability .5 can be written as the simple prospect $(\$1, .5; \$0, .5)$, or more simply $(\$1, .5)$. Given a set of prospects, a consumer valuates the different prospects using a two phase process. These two phases are the editing phase and the evaluation phase (Kahneman and Tversky, 1979). The editing phase consists of coding for a neutral reference point from which gains and losses can be evaluated, cancellation of identical prospects, omission of irrelevant information and combination of riskless payoffs. Some have argued that this initial phase is where much of the deviation from classical intuition derives itself (see Chioveanu & Zhou 2009) as consumers become confused with the "frames" that firms choose to deliver price information. We shall explore some of these ideas, but since the editing phase is not developed as formally as the evaluation phase it is harder to test hypothesis with it.

The evaluation phase is concerned with the valuation of prospects after editing has occurred. The formulation of how individuals evaluate prospects is the cornerstone of prospect theory and it is developed much more formally than the editing phase. The most important theoretical apparatus with respect to the evaluation phase is overall value function for prospects

(which should be differentiated from the value function for payoffs; see below). Given a regular prospect $(x, p; y, q)$ where x is some non-zero payoff with probability p and y is some non-zero payoff with probability q the overall value of the prospect is defined by

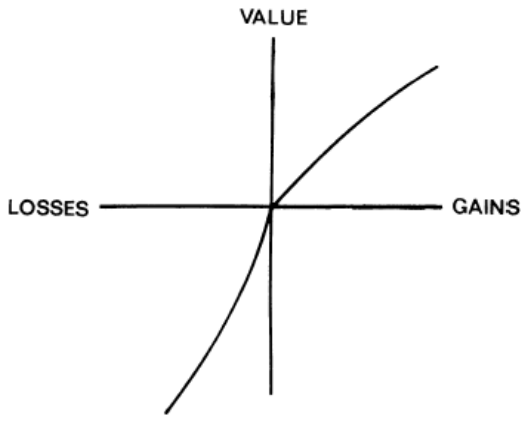
$$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y).$$

Where *V* is the overall value function, π is the probability weight function of a perceived or known probability and v is the value function that assigns a real valued number to an outcome.

The value function for payoffs, *v*, is defined as being concave for gains (as in utility theory) but convex for losses (see figure). In general, this implies that given an outcome x

$$|v(x)| < |v(-x)|$$

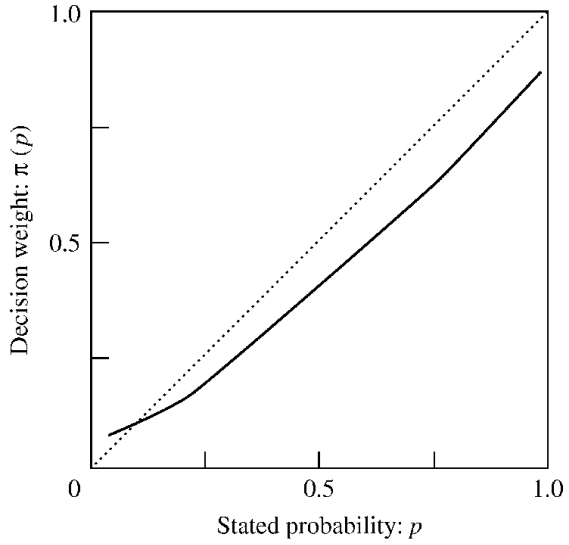
This function integrates asset position neutrality as it strictly evaluates gains and losses from prospects and not the resulting overall asset positions. I shall use the term "value function" to refer to *v* for the remainder of this paper.



The value function v(x). ***Source: Kahneman and Tversky 1989***

Kahneman and Tversky also observed that people have a probability weight function π that is not always proportional to probabilities. In particular, they found that, faced with a low

probability event, people tend to overweigh p $(\pi(p) > p)$ and when faced with a merely probable event, people tend to underweigh p $((\pi(p) < p;$ see figure). They called this characteristic of the weight function *subadditivity* since it implies in some cases that $\pi(p) + \pi(1-p) < 1,$ a violation of probability theory for probabilities where $p + (1-p) = 1$. Tversky and Fox (1995) more specifically found evidence of bounded subadditivity in weight functions implying individuals behave more extremely when information about the probability of a prospect changes at the boundaries (near $p = 0$ and $p = 1$) than when it changes elsewhere. This is expressed graphically by discontinuities at $p = 0$ and $p = 1$.They also found that this effect is amplified when probabilities are uncertain or unknown.



Source: Kahneman and Tversky (1979, p. 283)

A typical probability weight function

One interesting property of the overall value function V is that given a preference between two positive prospects (i.e. both only having positive outcomes) the preference order is reversed when the same outcomes are made negative (what is known as *the reflection effect*). This is a result of loss aversion which merely reflects the convexity of the value function for losses. This phenomenon suggests a completely different approach to evaluating choice problems. It predicts that people are more risk averse when it comes to choices between gains- as expected utility theory predicts- but risk loving when it comes to choices between losses (i.e. decision maker will be more likely to gamble a large loss than take a somewhat smaller certain loss).

Other predictions of the framework established by prospect theory are manifold and I shall discuss those that are relevant to the experiment in the following section.

3.2 Partition Inequality under uncertainty

Tversky and Fox (1998) showed that under uncertainty, the choice problem for an individual can be understood through a two-stage model where an individual determines the probability of an event and then uses their weight function to assign a weight to that probability. More formally if S is the set of all possible events and A is some event in S with payoff x then stage one of the valuation is expressed as $v(x)W(A)$ where W is the weight function defined on subsets of S. Recall that v is the value function of payoffs. In stage two the valuation becomes $v(x)\pi[P(A)]$ where, once again, π is the probability weight function and $P(A)$ is the assessed probability of event A occurring. This framework creates violations in classical models of expected utility and risk aversion as Tversky and Fox demonstrate: Suppose A is an event associated with a payoff of x that occurs with probability P. Let $C(x, A)$ be the certainty equivalent for some consumer with this prospect- that is, the monetary amount that would make the consumer indifferent between taking the risky prospect and taking the monetary amount. Classical decision theory implies that any partition of A into subevents $\{A_1, A_2, \dots, A_n\}$ will have the following partition inequality:

$$C(x, A_1) + \cdots + C(x, A_n) \leq C(x, A)$$

for all real x and $A \subset S$ where S is the set of all possible events. This implication is a result of risk aversion (see Fox and Tversky, 1998). Under the two-stage model, however, the partition inequality may be violated as bounded subadditivity implies that individuals overweigh low probability events. Therefore, if the event A is partitioned into many low probability events the sum of the certainty equivalents of the partitions could, in fact, exceed the certainty equivalent of the overall partitioned set. This leads to the conclusion that decision makers may, on average, pay a premium for specificity.

This phenomena is also observed by Johnson et al (1993) in experiments on choice preferences in the insurance market. It was shown with statistical significance that people are likely to assign a higher value to an insurance plan when it is separated into independent

components than when it was presented as all inclusive. If a similar effect is true in cell phone markets, as I predict it is, the consequences for the industry are drastic as cell phone plan providers will be able to increase revenues by simply making descriptions of their plans more specific.

3.3 Endowment/Status quo effects and framing

Given a set of choices prospect theory predicts that a change of reference point will affect, and sometimes invert, an individual's preference order (See Thaler 1980). This can be explained by the value function. A loss equal to a certain quantity will have a greater negative impact on the value function than a gain of equal quantity (once again, we expect $|v(x)| < |v(-x)|$). Therefore, depending on whether a prospect is viewed as a loss or a gain from the status quo, the resulting preference order is subject to change.

In particular, prospect theory predicts the endowment effect which states people will demand much more to give up a good than to acquire it (Knetch et al 1991). This follows because acquiring the good is viewed by an individual as a gain and falls in the gains region of the value function (which, again, is concave) and giving up the good is viewed as a loss and therefore falls in the loss region of the value function (which is convex). This can also explain why research has shown that sellers of a good will often demand more than buyers of the same good (see Cohen and Knetsch 1992).

Reference point is therefore central to any consumer decision-particularly in cell phone markets. I shall test in my experiment the hypothesis that the endowment effect affects the preference order of a consumer between cell phone plans.

3.4 Loss Aversion and segregated losses

As mentioned earlier, prospect theory models the value function as being convex for losses. This is equivalent to saying that decision makers are loss averse- they are more sensitive to losses than to gains. The value function for losses predicts that frequent small losses will be more "painful" to an individual than occasional big losses. Moreover, and relevant to consumer decisions in the cell phone market, decoupling the purchase of a good from its consumption (that is, paying for the good at a different time than consumption) will separate the perceived cost of the good (Thaler,

1980). This coupled with loss aversion predicts that a piece-rate plan that is based directly on usage should be less attractive than a flat rate plan that is paid less frequently. More formally the value function predicts:

$$\left|\sum_{i=1}^{n} v(x_i)\right| \geq \left|v\left(\sum_{i=1}^{n} x_i\right)\right|$$

For $x_i \leq 0$ (we assume that time value is taken into account as well). In terms of cell phone plans, this means that "pay for the minutes you use" plans will be less attractive to consumers than plans with flat rates- even though the former may be nominally cheaper than the latter. Shestakova (2010) finds evidence for this property in her experimental study of consumer preferences among different cell phone pricing schemes. Danaher (2002) similarly finds that for companies with dual pricing structures such as cell phones- a segregated flat monthly access fee component and a per-minute usage fee component- demand for access fees is less elastic and more influential on customer retention than usage fees that only start promoting a higher customer attrition rate when usage prices are so high they reduce usage quantity.

Even without usage fees, unpredictable losses from over-use fees may result in enough pain in terms of the value function that a consumer may be induced into purchasing a plan with unlimited usage. Purchasing an unlimited plan, in effect, eliminates the usage component of the pricing plan and therefore removes segregated losses from the valuation of the plan- making it more attractive.

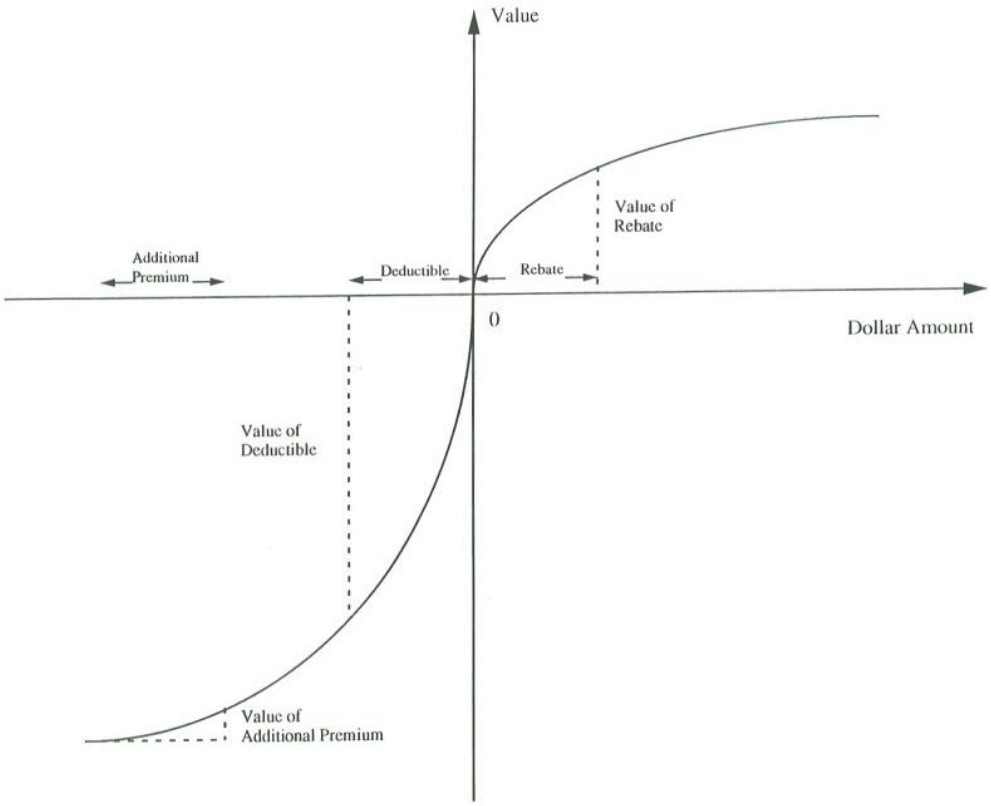
3.5 Diminishing Sensitivity

Related to the phenomena of aversion to segregated losses is the prediction of diminishing sensitivity along the value function. That is, if a loss or gain is perceived as far enough from the origin (point of reference), the effect of increasing that loss or gain by a certain amount will have a smaller effect on the value function than an increase of the same amount from the origin. This effect was tested for by Johnson et al (1993) in their experiments on insurance plans. They observed that people are willing to pay a higher premium on a plan that gives a rebate at the end of the year equal to $600 minus total claims than to pay for a $600 cheaper plan that only covers any

claims above $600 (i.e. a plan with a $600 deductible). Though choosing the first plan effectively gives the insurance company an interest free loan of $600 for a year, people still prefer it to the plan with the deductible. The property of diminishing sensitivity implies that, whereas the deductible is valued as a direct loss independent of the premium, the value of the extra premium on the other plan is relatively far from the origin and its negative value is offset by a potential positive gain from the rebate that is relatively close to the origin (see figure).

This phenomena also ties in with the framing effect and subadditivity of the probability weight function. Many insurance plans cover low probability events- which recall are overweighed according to prospect theory- and a consumer may give a high value for the potential loss of the deductible whereas the almost certain gain of the rebate in the other plan makes it attractive. Though not many cell phone plans offer rebates I expect to see a similar effect in tests on preferences for plans with this component.

Figure 1. Deductible and Rebate Frames



Source: Johnson et al (1993)

4 Experiment

4.1 Design

The experiment is a randomized online survey. This method seems like the most effective way to test my hypotheses since it allows for easy widespread distribution for a relatively low investment of material resources. Furthermore, the sample population- primarily college students- is likely used to taking surveys for clubs and classes and will therefore not require any extensive instruction on how to take a survey.

The survey consists of four questions about cell phone plans followed by four questions regarding background information (for a complete version of the survey see appendix A). Each of the first four questions will test for one of the following framing effect: violation of partition inequality, the rebate affect (i.e. diminishing sensitivity of the value function), free cell phone effect, and the endowment effect. Details for how these effects are tested for are described bellow in the results section.

At the beginning of the survey each subject is randomly assigned to one of six groups : $G_{11}, G_{12}, G_{21}, G_{22}, G_{31}$, or G_{32}. This allows for testing the effects of different versions of questions on answers. In the first part of the survey subjects are asked to assume a current cell phone plan that gives them a limited amount of monthly voice minutes, text messages, and data use equal to their current average monthly use. This is established as the neutral reference point. Subjects are also asked to assume that any usage exceeding this amount will result in unspecified per unit fees. On its own, this plan will result in fees from over-usage approximately half of the time and under-usage approximately half of the time. To alleviate any disposition to immediately want to drop this somewhat unrealistic plan I added the assumption of a "rollover" mechanism which accumulates any unused minutes, texts, and data used in one month and allows the user to consume them in the future. Therefore, while this makes the subjects perceive that no fees will be incurred on average, they will still recognize a possibility of receiving penalties since variability in usage is uncertain *ex ante*. Most cell phone users are most likely familiar with this mechanism but I provide an example at the beginning of the survey to clarify. Given that consumers are trying to match the amount of usage their plan will provide with their expected monthly demand for a fluctuating personal usage quantity (see Shestakova 2010 for a formal description of this property), this assumption seems like a fairly accurate depiction of a neutral point of reference for a typical

consumer with a limited-usage plan.

With this assumption in mind, subjects are presented four scenarios in which they have to choose a certain option from a list and/or give a value to particular cell phone products and services. Because I expect individuals to make decisions based off of incremental gains or losses (not total asset positions) I make the assumption that personal income and wealth levels will not be relevant in the decision making process.

4.2 Implementation

Data from the web-based survey was collected over the span of two weeks using the free online survey-design website psychsurveys.org. The features of the site allowed me to create a proprietary website URL which subjects could go to and take the survey at their convenience. I was also able to monitor the number of views and completed surveys in real time as well as the time taken by each subject to complete the survey.

A link to the survey was sent via email to a sample of students from Califronia Polytechnic State University at San Luis Obispo. Some students received course credit for taking the survey. Most emails were distributed to business and economics students via class mailing lists but individuals in the college of Agriculture, Architecture, Liberal Arts, Math and Science, and Engineering also participated.

There were a total of 82 participants who completed the survey. The average age of participants was approximately 20 years old. Of the 82 participants 24 (29%) stated that they paid for some or all of their cell phone bill (For complete participant demographic statistics see Appendix B).

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5 Results

5.1 Partition inequality violation

The first question of the experiment tests for a violation of the partition inequality as found by Tversky and Fox (1998). Assume that A_{total} is the event with perceived probability $P(A_{total})$ that an individual goes over his/her monthly allocation of voice minutes and text messages. Because there is no obvious reason for a consumer to perceive the events of overusing text messaging and overusing voice minutes as being dependent we can therefore partition A_{total} into two independent subevents: A_{txt} and A_{vm}- the event of going over allocated text messages and the event of going over allocated voice minutes, respectively. We can moreover assume that the consumer's value for an unlimited amount of texts and minutes, i.e. their value for insuring against the event of overusing texts and minutes (A_{total}), is equal to their certainty equivalent for the prospect that imposes fees on the consumer if A_{total} occurs. In other words, if the total cost incurred by A_{total} occurring is x then the amount a consumer will pay to forgo the lottery where the consumer loses nothing with probability $1 - P(A_{total})$ and loses x_{total} with probability $P(A_{total})$ is equal to $C(x_{total}, A_{total})$.

Furthermore if the partition inequality holds, as expected utility theory predicts, then we should have the following inequality:

$$C(x_{txt}, A_{txt}) + C(x_{vm}, A_{vm}) \leq C(x_{total}, A_{total})$$

In other words, the sum of the amounts individuals are willing to pay for unlimited text messaging and unlimited voice minutes separately should be less than or equal to the amount they are willing to pay for unlimited text messaging and unlimited minutes packaged together. If partition inequality is violated, as prospect theory predicts it will be in cases where the probabilities of the partitions are small enough, then the inequality will be reversed.

As Johnson et al (1993) mention in their paper it is hard to test for whether a particular price (i.e. for unlimited text messaging and minutes) is reasonable as consumers have different personal demand functions; it is possible, and more straightforward however, to test for consistency among choices.

To test whether consumer choices follow or violate the partition inequality I randomly

assigned three different versions of a question- one to each of three randomized groups. Groups G_{11} and G_{12} were asked to input the most they would be willing to pay in dollars for the addition of unlimited text messaging to their current plan. Similarly, Groups G_{21} and G_{22} were asked to assign their value for unlimited voice messages. Finally, groups G_{31} and G_{32} were asked to assign their value for a package that includes unlimited voice minutes and text messages. By taking the average of the values from each of the three groups I could test to see whether the sum of the means of the first two groups was less than or equal to the mean of the third group. Formally, my null hypothesis was $\mu_{txt} + \mu_{vm} \leq \mu_{total}$ where μ_i is the population mean of certainty equivalents $C(x_i, A_i)$.

Below is a summary of the results. Again, every group received the same question distinguished only by the italicized parts. Using a t-test for contrasts I found with statistical significance ($p < .02$) that the null should be rejected (see appendix B.1 for more details on the statistical test and D.1 for descriptive statistics). I therefore conclude with these results that the partition inequality is violated.

Table 1: Partition inequality

Many cell phone providers will provide extra features to your plan for an increased monthly rate. Suppose that in addition to your current plan, you are offered	
(1) *unlimited text messages*	[mean = $12.19, s.e. = 2.13, n = 31]
(2) *unlimited phone minutes*	[mean = $16.00, s.e. = 4.47, n = 24]
(3) *unlimited phone minutes and text messages*	[mean = $15.00, s.e. = 2.07, n = 27]
This addition will remain valid for the entirety of your contract. If the current price of your plan is the same as what you pay now, what is the most you would be willing to pay for this addition monthly? (Please enter a dollar amount)	

5.2 Decreasing Sensitivity of Value Function and Rebate Effect

The next question participants were asked to answer tests for whether a potential loss on a plan is less desirable than a potential gain paired with a premium. The value function predicts that consumers will dislike the former plan and favor the latter one. Similar to the experiment performed by Johnson et al (1993) on preferences between insurance plans with deductibles and more expensive ones with rebates, I test for this in cell phone plans by assigning two different versions of a question- one to groups G_{11}, G_{12}, and G_{21} and the other version to groups G_{22}, G_{31}, and G_{32}. Both groups are told that they have reached the end of their contract and are shopping for a new plan.

The first groups is given a choice between an unlimited plan for $90 that gives a $20 rebate at the end of the month if a certain threshold of minutes (equal to the current amount they are assumed to have with their limited-usage plan) is not exceeded and an unlimited plan for $80 that offers no rebate. The second group is given a choice between a plan similar to the one they are currently assumed to have for $70 that gives up to $20 of over-usage fees a month and, again, an unlimited plan for $80.

Prospect theory predicts that in the first group, individuals will favor the rebate plan and in the second group individuals will favor the unlimited plan. More generally- individuals prefer to pay a monthly premium for a potential rebate than to pay less and have looming potential losses. This preference can be explained using the value function- the low probability event of getting fees of up to $20 in the future is overweighed and is furthermore segregated from the total monthly plan cost of $70. Graphically, this implies that these potential losses from over-use fees are evaluated as negative increments near the origin- which is where the value function for losses has its steepest negative slope (see figure in section 2). On the other hand, the loss from the premium, equal to $20, is viewed as an addition to the monthly cost and occurs further from the origin- where the value function for losses is less steep. Therefore the magnitude of the loss from the premium, even though monetarily equivalent to the potential loss from fees in the first plan, is viewed as smaller. Moreover, the potential gain from a rebate is segregated from the monthly cost and thus viewed as a gain near the origin- where the slope of the value function for gains is greatest. This high magnitude potential gain offsets the low magnitude loss from the monthly premium and makes the rebate plan more attractive than the low cost plan.

The results of the experiment confirm this preference order. In the first (rebate) group less than 40 percent chose the $80 unlimited plan while in the second (no rebate) group more than 67 percent chose the unlimited plan. The difference in proportion was statistically significant using a z-test ($p < .01$). The results of the experiment are summarized in the table below.

It is interesting to note that the rebate plan, in effect, gives the phone company a $20 interest-free loan while the second plan may not even cost the individual a total of $90 month-even if they do exceed the threshold. Therefore, we would expect the second plan to be more attractive since total losses cannot exceed the first plan and would in some cases be much less (i.e. in the range between the monthly minute allocation and the $20 total fee cap). This suggests that loss aversion is a powerful psychological property of decision makers and may lead individuals to have preferences that are not very sensible from a purely monetary perspective.

Table 2: Rebate Effect

Now assume you are looking to renew your cell phone contract and you are presented with the following options (choose one of the following):	
(1) *Unlimited minutes on phone calls. Furthermore, if you speak under your average monthly amount you will get a rebate of $20. Plan cost: $90/month*	[62.2%, n=45]
(2) *You are given the same amounts of texts, minutes, and data usage as you were before. Furthermore, you will be charged 15 cents a minutes for up to $20 a month if you go over your allotted minutes. Plan cost $70/month*	[32.4%, n=37]
Or	
Unlimited minutes on phone calls. Plan cost: $80/month	

5.3 Free cell phone effect

The anecdote from the beginning of this paper about a surge in plan purchases following a decrease in cell phone price motivated the next experiment. This effect does not necessarily have an explanation using prospect theory but still seems crucial to test for. While time value of monthly payments accounts for the desire to spread the costs over the interval of a contract I showed that consumers exhibit an unrealistic discount rate in present value computations. This result implies that a plan with a low cost phone paired with high monthly payments is preferred to

a plan with a high phone price and low monthly payments- even though the former plan imposes higher costs when a reasonable discount rate is taken into account.

What exactly is a reasonable discount rate, however? While this paper does not try to analyze the different considerations that should go into evaluating the soundness of a consumers' discount rate, a topic on which there is undoubtedly a rich array of literature, I can make some assumptions that seem sensible. For example, the annual return of the stock market seems to be a fairly good metric of the rate of return consumers should expect on any investment on average. Therefore, we can compare the annual rate of return on some index of the stock market- such as the S&P 500- to the discount rates of consumers implied in their preferences between a low cost phone plan and a high cost phone plan.

To test for preference order and implied discount rates I gave all participant groups the following choice: a plan that gives a free cell phone paired with a $30 a month cost for internet use and a plan that gives a cell phone for $99 paired with a $20 a month cost. If a participant chose the free phone plan they were asked to state the highest phone cost in the $20 a month plan that would make them switch to it. Similarly if an individual chose the $20 a month plan they were asked to state the highest monthly rate in the free phone plan that would make them switch to it. These two figures can be viewed as indifference points and will allow me to compute the implied discount rates of the participants that chose either plan. Given the behavior observed in the market I predicted that most participants would choose the free cell phone plan even though this preference implies a monthly discount rate upwards of 9 percent (which furthermore implies an annual discount rate of more than 200 percent).

The results for the experiment are summarized in the table below. Contrary to my prediction, a majority of individuals did not choose the free phone plan. I did, however, find some evidence for high discount rates.

To test for high discount rates some samples that displayed negative discount had to be excluded. A negative discount rate implies that the individual believes that they will receive losses on any investment they choose in the future and therefore give a higher value to present consumption than to future investment. This lead to some participants always preferring one plan over the other and implied no indifference point. Therefore, in order to test for indifference points these participants were excluded. For the group that did not choose the free phone plan this included all participants who stated that a monthly rate of less than $24 would induce them to

switch to the free plan. At any positive discount rate this monthly rate results in a lower net present value for the free phone plan- a contradiction if one assumes discount rates are greater than zero. I also excluded all participants who stated that monthly rates higher than $30 would induce them to switch because this is also inconsistent with their preference. Of the individuals who stated an amount between $24 and $30 the mean indifference point was roughly $25. This implies a monthly discount rate of 4 percent or an annual discount rate of around 70 percent. We test this against the S&P average annual return since 1990 which is approximately 10.36 percent. Using a t-test I find a significant difference ($p < .001$).

It should be noted that the results of this experiment had a very high variance and many of the indifference points stated by participants did not make much sense even in the framework of prospect theory. Furthermore, using the average return of the S&P 500 (which is itself highly variable) as a benchmark for reasonable discount rates poses some problems as well. Looking at monthly returns of the S&P we see that in some months returns exceeded the average discount rate found in this sample. Even so, the average monthly return since 1990 is around .4 percent, which is still significantly lower than the 4 percent implied discount rate in the sample. I should note that the maximum monthly return during this period was 11 percent.

Another problem with testing for discount rates has to do with the design of the experiment. The cell phone price and monthly rate combinations, as stated in the survey, made the discount rate extremely sensitive to small changes in points of indifference. It is unlikely that an individual can make mental computations down to the cent to decide whether one plan is better than another but a change of a dollar in the point of indifference results in large percentage changes in the implied discount rate. This should be taken into account for future research on this phenomenon.

Table 3 : Free Phone Effect

You are purchasing a two-year phone plan and you have narrowed down all possibilities to two options. (Assume both plans offer the same amount of voice minutes and text messages) Choose one:	
a.) Receive a free smart phone and pay $30 a month for unlimited internet use	[26.8%]
b.) Receive a smart phone for a reduced price of $99.99 and pay $20 a month for unlimited internet use	[73.2%]
	[n=82]

5.4 Endowment effect

The final question of my survey tests for the endowment affect. Once again, three versions of the question were distributed to the three randomly assigned groups. Participants were told that they had some current plan and that a representative from the phone company has called them to propose some alternative plan. They are then asked to choose whether to keep their current plan or switch to the alternative. The first group (the full coverage group) is told that their current plan costs them $100 a month and gives them unlimited usage (minutes, texts, and data use); they are furthermore given the option of capping their usage for a monthly discount of $20. The second group (the limited coverage group) is told that their current plan costs them $80 a month and gives them limited usage (minutes, texts and data use); they are furthermore given the option of switching to an unlimited plan for an extra $20 a month. A third group (the neutral group) is told that they don't currently have a cell phone plan and that they can choose between a limited-use plan for $80 a month and an unlimited-use plan for $100 a month (see table below). Each group was furthermore asked to specify what price for the plan they didn't choose would induce them to switch to it.

Let us call the unlimited plan U and the limited plan L. The endowment effect implied by prospect theory predicts that individuals in the full coverage and limited coverage groups are likely to value their current endowed plan more than the alternative plan. In other words more individuals in the limited coverage group (who are endowed L) will choose the L over U than individuals in the full coverage group and vice versa in the full coverage group. This is because for the full coverage group, giving up U means a loss of the features of the plan which has a greater impact on the value function than the monetary gain of switching to L. Similarly, for a participant in the limited coverage group to switch to U she must incur a monetary loss which has a larger impact on her value function than the gains from the added usage amount.

A summary of the results of the experiment are displayed below. The prediction that less individuals in the full coverage group will choose L than individuals in the limited coverage group is verified with statistical significance ($p < .02$). Only around 32 percent of participants in the former group chose the limited plan compared to around 58 percent in the latter group. Individuals in the full coverage group demanded, on average, a discount of around 22% (or $17) on the limited plan while individuals in the limited coverage group demanded, on average, a

discount of around 12% (or $12) on the unlimited plan.

These results support the claim that endowment plays an important role in decision making. If no endowment effect was present we would expect to see around the same amount of people choosing L over U in both groups. As we have seen, this is not the case.

Table 4: Endowment Effect

[Full Coverage] *Suppose your current plan costs $100 a month. This gives you unlimited voice minutes, texts, and internet use. A representative of the cell phone company calls and offers you the option of putting a "cap" on your usage that would decrease the number of voice minutes, texts, and data you could use a month... this "cap" would decrease your monthly cell phone bill by 20% ($20). Do you switch to the limited capped plan or stick with your current unlimited plan?*	[Limited : 32.3%, n=31]
[Limited Coverage] *Suppose your current plan costs $80 a month. This gives you a block of voice minutes, texts, and data based off of your average usage... A representative of the cell phone company calls and offers you the option to acquire unlimited texts, voice minutes, and data use. Switching to this unlimited plan will increase your monthly cell phone bill by 25% ($20). Do you switch to the unlimited plan or stick with your current limited plan?*	[Limited: 58.3%, n= 24
[Neutral] *Suppose you want to switch to a new cell phone plan. A representative from the cell phone company calls and tells you that you can choose one of the following two plans: the first plan puts a cap on the number of minutes and texts you can use based off of your average use. The other gives you unlimited texts, minutes, and internet use. The first "limited" plan costs $80 and the second "unlimited" plan costs $100. Which plan do you choose?*	[Limited: 33.3%, n=27]

6 Conclusion

This paper tested certain framing effects in the cell phone industry that may explain some counter-intuitive behavior that has been observed by economists and market analysts. I predicted that cell phone use is characterized by uncertainty and that models that explain more uncertain markets, such as those in the insurance industry, would yield similar results in the cell phone industry. Using the tools of prospect theory developed by Khaneman and Tversky I formulated theoretical models to explain some of the consumer behavior that has been observed in cell phone markets and posit predictions for how a consumer's preferences would be ordered under certain conditions. In particular, I tested to see whether partition inequality (or a violation thereof), the rebate effect, the free cell phone effect, and the endowment effect can be observed of individuals

when put in the context of cell phone consumers.

Using a randomized survey experiment I found evidence for violations of the partition inequality, the rebate effect, and the endowment effect in cell phone markets. I did not find significant evidence for the free cell phone effect which I defined as an increase in attractiveness of a plan due to a decrease, or a complete elimination of a cell phone price component. I did find some evidence to suggest that abnormally high discount rates could result in an increased value for a plan with less upfront costs. This evidence, however, is still somewhat inconclusive.

There are four main implications of this study. Firstly, the finding of a violation of the partition inequality suggests that a cell phone plan with its components broken up (and perhaps sold separately) will receive an overall higher valuation from consumers. In other words, as Tversky and Fox note, people pay a premium for specificity. Moreover the finding that plans with rebates (though at present do not seem widespread) are more valued than cheaper plans with potential losses- even if the latter is monetarily less costly than the former suggests a good marketing opportunity for plan providers and an aspect of plans for consumers to beware of. Similarly, the effects of endowment on consumer behavior suggests that offering an expensive unlimited plan as "normal" and a less expensive limited one as a "cap" will attract more consumers to the former plan than the latter.

Lastly, this paper has shown that the tools of prospect theory, and the assumption of consumer uncertainty, appear to be valid in describing consumer behavior in cell phone markets. This means that to better understand consumer behavior in cell phone markets, and in similar markets, it would benefit researchers to emphasize the aforementioned framework rather than that of expected utility theory.

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APPENDIX A: SURVEY

Note: Pages shown in order. Only one version of the survey is shown below. For alternate versions of questions please see "5-Results"

Cell Phone Questionnaire

EXIT AND COMPLETE SURVEY LATER

Hello!

The following survey consists of 4 questions regarding cell phone plans followed by 4 informational questions about yourself. Some questions will require you to type information. Please read the questions carefully and answer them to the best of your ability. If, for whatever reason, you have to exit this survey before finishing please click on the "Exit and Complete Survey Later" button at the top of the screen. Upon clicking the button you will be given instructions on how to return to where you left off.

CONTINUE TO NEXT PAGE

OCOB Student Information

If your instructor is giving you course credit for taking this survey please fill out the information below. Otherwise, feel free to continue on to the rest of the survey.

1: Instructor

2: Your full name

3: Your @calpoly.edu email address

Part I

For the following 4 questions (unless stated otherwise): assume you currently have a cellphone plan with a limited block of minutes, texts, and data usage. You may assume that these quantities are equal to your average monthly usage and that you may also "roll-over" any unused minutes, texts, or data use from one month to the next. Also assume that there are penalties (fees) for each minute, text, and or megabyte of data you use over your allotted quantity.

For Example: assume that your plan allows you 600 voice minutes, 100 texts, and 200 megabytes of data use a month. Therefore, if this was your usage for three months:

Jan: 590 voice minutes, 90 texts, 150 megabytes
Feb: 610 voice minutes, 110 texts, 250 megabytes
March: 610 voice minutes, 110 texts, 250 megabytes

You would have accumulated 10 voice minutes,10 texts, and 50 megabytes of data in January, used up these texts, minutes, and data in February (so that your net texts, minutes, and data was zero) and incurred penalties on 10 voice minutes,10 texts, and 50 megabytes of data in March.

Assume that prices in this survey include all taxes.

Part I: Question 1

1: Many cell phone providers will provide extra features to your plan for an increased monthly rate. Suppose that, in addition to your current plan, you are offered unlimited phone minutes. This addition will remain valid for the entirety of your contract. If the current price of your plan is the same as what you pay now, what is the most you would be willing to pay for this addition monthly? (Please enter a dollar amount)

Part I: Question 2

1: Now assume you are looking to renew your cell phone contract and you are presented with the following options (choose one of the following):

- a.) You are given the same amounts of texts, minutes, and data usage as you were before. Furthermore, you will be charged 15 cents a minutes for up to $20 a month if you go over your allotted minutes. Plan cost $70/month
- b.) Unlimited minutes on phone calls. Plan cost: $80/month

Part I: Question 3

1: You are purchasing a two-year phone plan and you have narrowed down all possibilities to two options. (Assume both plans offer the same amount of voice minutes and text messages) Choose one:

- a.) Receive a free smart phone and pay $30 a month for unlimited internet use
- b.) Receive a smart phone for a reduced price of $99.99 and pay $20 a month for unlimited internet use

2: If you chose a.), what is the highest cell phone price in b.) (below $99.99) that would make you reconsider your decision? (if you chose b.) leave this blank)

3: If you chose b.) what is the highest monthly rate in a.) that would make you reconsider your decision? (if you chose a.) leave this blank)

Part I: Question 4

1: Suppose your current plan costs $80 a month. This gives you a block of voice minutes, texts, and data based off of your average usage. (standard overage fees apply in the case your usage exceeds this amount) A representative of the cell phone company calls and offers you the option to acquire unlimited texts, voice minutes, and data use. Switching to this unlimited plan will increase your monthly cell phone bill by 25% ($20). Do you switch to the unlimited plan or stick with your current limited plan?

- Switch to unlimited plan ($100)
- Stick with limited plan ($80)

2: If you chose to switch to the unlimited plan, how much more would this unlimited plan have to cost for you to stick with your current limited plan? (Please state the total price you would pay) If you did not switch to the unlimited plan please leave this blank.

3: If you chose to stick with the limited plan, how much less would the unlimited plan have to cost for you to witch to it from your current limited plan? (Please state the total price you would pay) If you chose to switch to the unlimited plan please leave this blank.

Part II: Background Information

1: What is your age? (please enter a number)

2: What is your gender?

3: What college are you enrolled in?

4: Do you pay for part or all of your monthly cell phone bill? (please check the box if yes, leave blank if no)

End

Thank you very much for taking this survey! Have a great day! (please close this window to exit)

APENDIX B: SAMPLE STATISTICS

Table B.1: Gender Distribution

Gender	Number	Percent
Male	42	51%
Female	40	49%
Total	82	100%

Table B.2: College Distribution

College	Number	Percent
Business	38	46%
Engineering	9	11%
Agriculture	12	15%
Architecture	7	9%
Liberal Arts	12	15%
Math and Sci.	2	2%
Unspecified	2	2%
Total	82	100%

Table B.3: Age Distribution

Age	Number	Percent
18	14	17%
19	29	35%
20	15	18%
21	12	15%
≥ 22	12	15%
Total	82	100%

Table B.4: Contribution Distribution

Contribute?	Number	Percent
Yes	24	29%
No	58	71%
Total	82	100%

Note: Table B.4 refers to whether a participant responded “yes” or “no” to the question “Do you pay for part or all of your monthly cell phone bill?”

APPENDIX C: STATISTICAL TESTS

C.1 t-test using contrasts

A contrast is a linear combination of two or more factor level means whose coefficients add up to zero. In my test for a violation of the partition inequality (see 4.1) I tested for the contrast:

$$\mu_{txt} + \mu_{vm} - \mu_{total} = 0$$

Or, in other words, whether the sum of the mean certainty equivalents for unlimited text messaging and unlimited voice minutes is equal to the mean certainty equivalent of a combination of unlimited text messaging and unlimited voice minutes.

A t-test for whether the sum of the means of the partitions exceeds the mean of the set has the following null and alternative hypothesis:

$$H_0: \mu_{txt} + \mu_{vm} \leq \mu_{total}$$

$$H_a: \mu_{txt} + \mu_{vm} > \mu_{total}$$

Using our sample averages $\bar{x}_i$ and s_i as estimates for μ_i and σ_i our t-statistic here is defined as:

$$\frac{(\bar{x}_{txt} + \bar{x}_{vm} - \bar{x}_{total}) - 0}{SE}$$

Where $SE = \sqrt{\frac{{s_1}^2}{n_1} + \frac{{s_2}^2}{n_2} + \frac{{s_3}^2}{3}}$. The resulting t-value was assessed a t distribution using the appropriated degrees of freedom to obtain a one-sided p-value (I used the Microsoft Excel TDIST function). For my test I used the most conservative approach for the degrees of freedom- the $d.f.$ for this contrast is at least $d.f. = \min\{n_i\} - 1$. For my sample this was equal to 23.

C.2 z-test for difference in proportion

In my tests for the free phone effect, the rebate effect, and the endowment effect I used a two proportion z-test to test for the differences in the proportions of individuals who chose one preference as opposed to another.

If two or more groups are given a question with a binary answer, option a and b one can

test whether the proportion of people in group 1, π_1, who chose option a is equal to the proportion of people in group 2, π_2, who chose option a using the test statistic

$$z = \frac{\pi_1 - \pi_2}{SE}$$

Where SE is derived in the following manner: the pooled sample proportion, π, is first obtained:

$$\pi = \frac{\pi_1 n_1 + \pi_2 n_2}{n_1 + n_2}$$

Then $SE = \sqrt{\pi(1-\pi)\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}$. For test where $H_a: \pi_1 > \pi_2$ we evaluate one tail of a normal distribution at z to get a p-value.

APPENDIX D: EXPERIMENT RESULTS

D.1 Partition Inequality

Table D.1_1: Descriptive Statistics

Group	G_{txt}:Text Messages	G_{vm}: Voice Minutes	G_{total}:Text Messages + Voice Minutes
N	31	24	27
Mean	12.2	16.2	15.0
Median	10.0	10.0	10.0
Variance	140.8	480.1	115.4
Stdv	11.9	21.9	10.7
S.E.	2.1	4.5	2.1
Max	50.0	100.0	60.0
Min	0.0	0.0	5.0

Table D.1_2: t-test

$\bar{x}_{txt} + \bar{x}_{vm}$	28.36
$\bar{x}_{total}$	15
Difference	13
SE	5.37
T	2.49
P	0.01
Conclusion	**Reject Null**

D.2 Rebate Effect

Table D.2_1: Descriptive Statistics

Group	Rebte	No Rebate
N	45	37
Chose unlimited ($80) plan	17	25
Proportion	0.377	0.675

Table D.2_2: Test for Significance

Pooled Sample proportion	0.512195122
SE	0.11092785
Z-Stat	-2.685510427
P	0.00362
Conclusion	**Reject Null**

D.3 Free Phone Effect

Table D.3_1: Descriptive Statistics

N	82
Free	22
Not Free	60
p(free)	0.268
Conclusion	**Fail to Reject**

Table D.3_2: monthly rate to make participants who chose "Not Free" indifferent

Mean	25.35
Stdev	1.62
implied discount (monthly)	0.048
implied discount (annual)	0.761

D.4 Endowment Effect

Table D.4_1: Descriptive Statistics

Group:	Full Coverage	Limited Coverage	Neutral
N	31	24	27
P(limited)	0.323	0.583	0.333
Indifference	17.62	12	19.03

Note: "Indifference" refers to the average discount demanded on the alternative plan by participants who chose their endowed plan. For the Neutral group, the average of the discount demanded by those who chose "Full" and those who chose "Limited" is shown.

Table D.4_2: Statistical Tests for Significance

Test (H0)	$P2 \leq P1$	$P3 \leq P1$	$P2 \leq P3$
SE	0.134	0.123	0.14
Z	-1.934	-0.0870	-1.79
P	0.0266	0.468	0.0367
Conclusion	**Reject**	**Fail to Reject**	**Reject**

Note: For this table Pi refers to the proportion of individuals in group i who chose the limited plan. Here group 1 is the full coverage group, group 2 is the limited coverage group and group 3 is the neutral group.