A Tale of Two Judgments: Biases in Prior Valuation and Subsequent Utilization of Novel Technological Product Attributes

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Abstract

We explore the degree to which consumers' willingness-to-pay for next-generation products is rationally consistent with levels of utilization of novel features displayed after adoption. Using data from an experiment that requires subjects to buy and then utilize successive generations of an arcade game, we find support for an *overvaluation bias*: respondents place a high value on the ability to acquire an enhanced game form, but then make limited use of its novel controls after adoption. The effect is shown to be robust to incentives that provide a monetary reward to accurate valuations, priming of forecasts of downstream usage, and allowing subjects brief periods of trial ownership. The bias is explained in terms of myopic buying-and-utilization processes where *a priori* assessments of value do not anticipate future usage, and *post-hoc* decisions about utilization do not feel obligated to past valuations.

Keywords: Consumer Learning, Consumer Decision Making, New Product Research, Innovation

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A recurrent challenge faced by manufacturers of durable goods is how to enhance the appeal of existing generations of product offerings. While product innovation is never easy, what makes the process particularly difficult in the case of multi-generational marketing is that design enhancements must be delivered in a way that precludes consumers from having to incur re-learning or switching costs. As eager as current users may be to adopt innovations that improve upon the a good's performance, this eagerness may quickly fade if improvements can be realized only by replacing their current, hard-won, usage skills with a completely new ones.

. Fortunately, this product-development dilemma has a common design solution that is widely recognized by firms: rather than re-engineering products from scratch, new product features are often introduced as *augmentations* to existing designs, a strategy that allows consumers to choose the time and place they wish to learn them. Hence, for example, when Microsoft introduced the *Windows XP* operating system as a replacement for earlier generations of Windows it retained for users an ability to "revert to the classic view" of the control panel, and when Audi first offered its "Tiptronic" transmission that added the flexibility of manual operation, the default mode of operation and console appearance continued to be that of a traditional automatic. Likewise, few manufacturers of cell phones and digital cameras would think to add new features without retaining the same functionality of earlier generations.

Yet, this design strategy is far from fail-safe, as it has a rather subtle downside risk: if consumers are shrewd students of their own psychologies, some may reject new product generations because, paradoxically, their design makes it *too easy* for them to avoid developing new usage skills. That is, by making it easy to revert to using familiar controls and usage protocols, consumers may forecast that they will underutilize new attributes offered by a next-generation good, hence be rationally reluctant to pay for it despite its potential advantages. Manufacturers may thus find themselves facing the dilemma that the more satisfied consumers are with a current generation of a good, the less willing they may be to pay for the opportunity to upgrade to a new generation—not because of performance satiation, but because of pessimistic predictions about their own future product-usage behavior.

Do consumers make these kinds of projective assessments of product usage when making product purchase decisions, and, if so, how accurate are they? The answer to this question is largely unknown. Although the literature examining how consumers respond to product innovations is large (e.g., Moreau, Lehmann, and Markman 2001; Mukherjee and Hoyer 2001; Nowlis and Simonson 1996), little work has examined the specific question of how consumers make predictions about their future utilization of innovative product attributes at the time of purchase, and how these predictions compare to their actual usage after adoption.

The purpose of this paper is to report the results of such an investigation. We describe the results of a series of experiments in which subjects are trained to play a novel arcade game that offers monetary reward based on their ability to move a screen icon with a set of tactile controls. Subjects are then given the opportunity to purchase and continue play with a new generation of the game that augments these controls with a set of ones. The paradigm is one that allows investigation of a range of questions about how consumers predict and value their future utilization of novel product features, and how accurate these predictions turn out to be in light of their actual post-adoption usage behavior.

The core finding of the work is support for an *enhancement paradox* in new-product adoption decisions. When given the opportunity to purchase an enhanced game platform, subjects, on average, reveal a willingness to pay that is in excess of that which they could reasonably hope to recoup in though higher game scores, implying excessively optimistic beliefs about the value of the additional set of controls. Upon acquiring the new platform, however, interest in these new controls vanishes; players withdraw use of the new controls after overly-short periods of experimentation, and ultimately realize lower game payoffs compared to those who either chose not to upgrade or were never given the opportunity.

We organize our presentation of our research in three phases. We first develop a more complete background for the research by reviewing the normative basis for consumer new generation-adoption decisions and exploring prior behavioral research that suggests how actual decisions may depart from this benchmark. We then test these hypotheses using data drawn from a sequence of three laboratory experiments. We conclude with a general discussion of the implications of the work for both basic research in consumer response to product technologies as well applied work in new-product design.

The Psychology of New-Product Attribute Valuations

The normative basis of novel attribute assessments

In this work we consider how consumers solve a particular class of new-product adoption problems that have the following structure. A consumer currently owns a durable good that conveys utility through a set of discrete features that deliver a known level of performance on each usage occasion. An example might be familiar text-editing controls on a software package, or controls on a television monitor that adjust picture quality. The level of performance yielded by these familiar features is acceptable to the consumer, but short of that which would be considered ideal. A manufacturer then offers the consumer the opportunity to pay to replace this incumbent with a new generation that augments the original features with a new set of tools that may better meet that same goal; for example, a supplemental set of editing controls, or a new method for of adjusting picture quality. The addition of these features does not affect the functionality or performance of the old set, and there is no combined usage; on each usage occasion the consumer decides whether to use either the old features or the new. While the performance delivered by the familiar features is known, the performance of the new features is uncertain. The consumer only knows that there will likely be a learning curve, and that the long-run utility derived from using the new features may or may not be higher than that provided by using the incumbent. The consumer's task is to decide whether it is worthwhile to pay to replace the incumbent good with such a new-generation replacement.

Is there a right solution to this problem? An economist might recognize this as an example of as a *real-options* problem, a well-known class of sequential decision tasks where a decision maker must decide at some time point whether to initiate investment in an instrument whose true value can only be learned by experience (e.g., Dixit and. Pindcyk 1994). Applied here, the intuition would be straightforward: because the reward to be gained from using the new features is not fully known at the time of purchase, by buying the product the consumer is paying for the opportunity to discover their value and then have the option to utilize them should their value prove superior to the old. The normative value of the new generation is thus the discounted long-term expected value of acquiring the good with its new features, discovering their true value, and then making a series of optimal usage decisions based on what had been learned.

But whether options theory might serve as a good *descriptive* model of how consumers value new-product attributes is, of course, another matter. To compute an option value the consumer would not only need to possess such things well-formed beliefs about the probability distribution that characterizes the variance in possible true performance values, but also—and more critically--an ability to foresee in an unbiased manner how future decisions will be made about using the new feature in light of what is learned about performance.

Will valuations accurately anticipate usage?

While we are not aware of work that has examined the ability of consumers to anticipate the utility they will derive from new-product features, there is a broad array of evidence from research on both intuitive forecasting and consumer response to product innovations that suggests such this ability may be limited. To illustrate, one of the most robust results of behavioral decision theory is the finding that individuals tend to be poor predictors of the choices they will make in the future and how they will feel about them. To illustrate, consumers tend to over-forecast the amount of variety they seek in food products when predicting future choices over time (e.g., Simonson 1990), over-forecast the extent to which they utilize virtuous subscription goods such as attendance at health clubs (e.g., DellaVigna and Malmendier 2002; Gourville and Soman 1998), and under-forecast the speed with which they emotionally adapt to unpleasant life changes, such as being dismissed from a job (Wilson and Gilbert 2003).

Although a number of theoretical explanations have been offered for these kinds of errors, a common theme is that they originate in a tendency for expectations about the future to be excessively anchored by what is observed and felt in the present (e.g., Lowenstein, O'Donoghue, and Rabin 2003; Gilbert, et al 1998; Wilson and Gilbert 2003). Hence, consumers over-forecast usage of health clubs because of a mis-founded belief that the enthusiasm for fitness that motivated them to join will persist long into the future, and over-estimate future needs for variety by imagining the variety that would be preferred if all goods were to be consumed now. We should thus not be surprised if consumer forecasts of the value they will get from new-product attributes turn out to be similarly prone to error; anchored, for better or worse, toward the initial visceral reactions evoked by these attributes.

But will such forecasting errors have a particular directional bias? On the surface one could argue the matter either way: consumers who see themselves as technological laggards could be prone to under-predicting the value they will realize from attribute innovations, while those who see themselves as innovators might over-predict it. But there is suggestive evidence that these two scenarios may not be equally likely: if there is a systematic bias it will tend to work in the direction of consumers over-forecasting the amount of utility they will actually realize from new product features.

The rationale for this hypothesis has two facets. First, a number of authors have offered evidence that when consumers are faced a choice among unfamiliar product options alternatives that have been enhanced by novel-sounding ingredients or labels are often preferred—even when these features have little potential of enhancing the actual objective performance of a good. Carpenter, Glazer, and Nakamoto (1994) and Brown and Carpenter (2000), for example, report examples where consumers are more likely to choose products that have been enhanced by substantively meaningless attributes, such as coffee beans that been subject to a "high-altitude roasting process", and Gelfand-Miller and Kahn (2002) report that consumers are more likely to prefer colors that have merely been given exotic differentiating names, such as "flame red". While there is no one simple explanation for these findings, most accounts center on the idea that when there is no overt objective basis for making a choice consumers turn to tie-breaking heuristics that yield the most justifiable outcomes—such as following the conversational norm that innovations tend to have positive value (Brown and Carpenter 2000; Gelfand-Miller and Kahn 2004). Indeed, reinforcing this view is the fact that "meaningless differentiation effects" tend to vanish when an options differ on attributes that consumers see as overtly important (Brown and Carpenter 2000).

Another basis for conjecturing that initial reactions to the new generation will be positively skewed is the attraction individuals often hold for options that provide flexibility, or permit them to "keep doors open" (see, e.g., Shin and Ariely 2004). Recall that in the current context new features are added as *augmentations* to existing features whose use is purely discretionary. As such, even if consumers doubt whether the new features provide any value, they might wish to acquire anyway them simply as a hedge against them *possibly* becoming valuable in the future. Such reasoning, of course, is the essence of rational options analysis as we described at the outset. We suggest, however, consumers' valuations of flexibility will be excessive and visceral, not based a formal analysis of the future value of holding and exercising options as required by normative theory.

If they buy it will they use it? The second facet of our argument centers on whether such positive initial assessments—whatever their basis—will be consistent with subsequent usage of the product conditional on ownership. As noted above, under normative theory a consumer's willingness to pay for a next-generation product should reflect his or her beliefs about the future rate of usage and utility provided its new features. A consumer who displays a high willingness to pay for the new generation, therefore, is expressing strong priors that the new features will turn out to be worthwhile, and that they will be frequently used. Assuming these expectations are rational (i.e., statistically unbiased), an enthusiastic adopter should thus also emerge, on average, as an enthusiastic user. In addition, even if a consumer is too optimistic about the true value of the features, she should also display higher usage rates by virtue of being a more persistent experimenter; being a Bayesian, these strongly-positive priors would demand a higher level of sample evidence to reject a null hypothesis that the new control did *not* have value[1]

But will *a priori* valuations indeed be consistent with *post-hoc* usage? It is here where we find the seeds of a potential paradox. In contrast to work showing that consumers are prone to see positive value in uncertain novel product attributes, work that has examined how consumers *utilize* new designs often finds an opposite bias—one of being averse to adopting novel methods of utilization when more familiar ones are readily available. Specifically, a systematic result of work on technological utilization is that when consumers have well-developed skills in utilizing one technology they often find it difficult to learn new ones, and are frequently averse to learning new skills—an effect called termed cognitive lock-in (e.g., Johnson, Bell, and Lhose 2003; Norman 1998; Zauberman 2003). The explanation is that expertise with using one generation of a technology characteristically increases as logarithmic function of practice (the power law), implying that the more familiar one becomes with one technology, the higher the short-term relative cost of learning to utilize new technologies (Klemperer 1987; Zauberman 2003). Although these findings have been derived from settings that differ from the current, its conclusions would nevertheless appear applicable: given a choice between utilizing a new attribute whose use incurs a learning cost versus a more familiar alternative, there will be a strong urge to recurrently choose the latter.

Can these opposing biases co-exist? We suggest they can, by the hypothesis that initial valuations and subsequent utilization will be driven by separate psychologically judgment processes. Initial valuations will be generated by myopic heuristics that attach a positive value to novelty, and utilization decisions will be guided by myopic trade-offs between costs and benefits

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[1] Note that this mechanism is different from a sunk-cost effect that would explain a similar positive relationship between investment and usage (see, e.g., Thaler 1985). In this case the dependence arises as a consequence of the normative dependence of sample sizes needed on the ability to reject a statistical prior.

that favor the recurrent use of familiar attributes. We can summarize this idea in terms of the following central hypothesis:

> ***H1: The paradox of enhancement****. When given the opportunity to purchase a new product that possesses an expanded set of attributes relative to an incumbent, consumers will display an overvaluation bias, revealing rates of adoption and levels of willingness-to-pay in excess of those that would be consistent with subsequent utilization rates and utility gains.*

Boundary conditions: the effect of experiences with the incumbent and product trial

The degree to which consumers may be prone to overvaluing innovations, of course, will likely vary over individuals and contexts. For example, a long-standing finding in behavioral decision making is that consumers tend to judge value not by absolute metrics but rather relative to norms or expectations (e.g., Kahneman, Knetsch, and Thaler 1990). One implication of this finding in the current setting is that it may give rise to a paradoxical *negative* relationship between the strength of the overvaluation bias and the intensity of prior positive beliefs about the new generation product; that is, those who hold the most optimistic priors about the value of a new generation may also be those who most quickly abandon use, and realize the most limited benefits from them. The rationale is simple: those consumers who express the highest willingness-to-pay for a new product generation would also likely be those who enter ownership with the most positive expectations about the level of pleasure or value that its new attributes will provide. Because even objectively-superior attributes will likely initial involve learning costs, *ceteris paribus* it is also these consumers who would feel the most acute sense of disappointment when the new attributes were finally tried out. The hypothesis that consumers focus only on comparative short-run be benefits would thus lead to premature abandonment, as consumers turn to more familiar attributes that, even if not materially better, at least do not impose a psychic loss. We summarize this idea as follows:

> ***H2: The conditioning effect of initial valuations.*** *The hypothesized tendency for prior valuations to outstrip subsequent utilization will be highest among those adopters who express the highest willingness-to-pay for the new generation, as evidenced by both levels of new-attribute usage and utility gains from the adoption.*

A second moderator of the overvaluation bias could be the amount of real knowledge the consumer holds about the new attribute. Intuition suggests that the hypothesized effect would vanish if consumers had direct knowledge about the performance of the new generation, such as might be gleamed from a period of trial ownership or usage. In this case valuation of the new generation would shift from being based on heuristic conjectures to being rooted in objectively-correct assessments of realized value, bringing valuation and usage in line.

But even if consumers emerge from a period of trial usage convinced that that they will make limited use of a few feature, high valuations may still persist due either to an exaggerated desire to retain the option for future use (e.g., Shin and Ariely, 2004) or the offsetting effects of endowment (Kahneman, Knetch, and Thaler 1990). Specifically, the brief period of trial ownership may be sufficient to cause consumers to view the new generation as an endowed possession that they will be reluctant to give up—even if it carries features that have limited material value. Hence, we hypothesize:

> ***H3: The robustness of overvaluation to trial ownership.*** *The hypothesized tendency for prior valuations to outstrip subsequent utilization will still be observed in contexts where consumers are permitted a period of trial ownership of the new-product generation*

Finally, it is natural to hypothesize the degree to which consumers are initially attracted to a new generation product—hence the size of the overvaluation bias--will depend on the quality of consumers' past experiences with the incumbent generation. For example, one might presume that consumers who are already quite satisfied with a current product and have invested sizable learning costs would have little interest in trading it in for a next-generation replacement, either because they would believe it unlikely that the new features would provide a significant improvement in satisfaction, or that gains will be slow in coming (e.g., Mukherjee and Hoyer 2001). Yet, it is far from clear that such a rational relationship will universally hold. As argued by Nowlis and Simonson (1996), satisfaction with a current good could, in some cases, *increase* the attractiveness of new generations if consumers believe that the first generation's high performance is an outgrowth of special skills possessed by the manufacturer in developing new products, or the decision maker's skill in *extracting* value. Likewise, high experienced learning might also simply be ignored or forgotten at the time of purchase. Past learning costs may be seen as irrelevant to the new generation if consumers believe that they have "learned how to learn" new technologies, or are simply under-attended to at the time of choice by being dominated by positively-valenced new-product valuation cues (see, e.g. Wilson and Gilbert 2002). Because of this ambiguity, we leave the question of how past product experiences will affect prior valuations as an open empirical issue to be explored in our empirical work.

Empirical Analysis

Overview and Design Considerations

We test the above hypotheses using data from a somewhat unusual experimental context: that involving the buying and utilizing of successive generations of an arcade-like computer game. In the experiment subjects are endowed with an initial generation of the game, and after a period of learning are given the opportunity to purchase and then utilize a new-generation replacement that offers an expanded set of controls.

The game was called “Catch’em” and bore similarities to the popular late 70’s and early 80’s arcade game *Pac Man.* In the game players viewed a grid on which, at the start, was superimposed a fifteen stationary green dots called “cookies”. Also on the grid were two larger red and black dots that depicted the staring position of the player and his or her robotic opponent, termed the “Monster”. Upon triggering the start of the game both the Monster’s and player’s icons began moving over the grid. While the Monster moved at a random speed and direction, the player controlled the speed and direction of his or her icon. Each time either the player’s icon (or the Monster) moved over a cookie ten points were scored for the player (or the Monster). If all of the cookies were consumed from the board by the player and/or the Monster, the play ended and the player received a point total equal to the number of cookies he or she had captured. If, however, at any point the Monster’s icon touched the player’s icon, the player’s icon was declared “caught” and play also ended, with all points having been earned to that point being forfeited.

We chose this stimulus context because it was one that satisfied four ideal design criteria:

1. It provided us with experimental control over the design and familiarity subjects had with a basic generation of a technology;
2. It allowed experimental introduction over the value of enhanced features in a new technology;
3. It provided a natural objective for measuring performance that could be used for providing a monetary incentive to subjects; and

4. The task context—an arcade game—was one that was likely to be seen as highly involving and familiar to the subject pool, primarily undergraduate college students.

Our manipulations centered on the quality and number of controls available to subjects for moving their icon. At the start of the game subjects were given ownership of a platform that was equipped with one of two types of controls:

1. *Scroll Bar Control (Figure 1a)*: Subjects continuously adjusted the speed and direction of movement of their icon by moving each of two horizontal scroll bars displayed on the computer screen. Use of the directional control was aided by a steering-wheel-like graphic that displayed the current directional heading of the icon.
2. *Button Control (Figure 1b).* Subjects adjusted speed and direction by repeatedly clicking two sets of button controls. One pair of buttons allowed subjects to reverse the current heading of their icon either horizontally or vertically, while the other pair induced discrete increases or decreases in speed.

After the completion of a set of training rounds with one of these two platforms, subjects were then given the opportunity to purchase an enhanced platform that was equipped with *both* controls for use during the money rounds.

Experiment 1 provides a basic test of the valuation-utilization paradox (***H1***) as well as initial tests of the degree to which post-adoption usage is conditioned by prior valuations (***H2***). In Experiment 2 we attempt to more deeply probe the process that underlies the first set of findings through variant of the task in which forecasts of likely future control use data are gathered prior to the adoption decision. In Experiment 3 we examine whether over-valuation biases persist given the opportunity for trial ownership, and when consumers have the option to be paid to exchange the new generation good for an earlier generation.

Experiment 1

General Description

Subjects were 149 business-school undergraduates who volunteered to complete the task for a monetary incentive. Subjects performed the experiment seated in computer cubicles in the school's behavioral research lab. At the outset of the experiment subjects were told that the purpose of the experiment was to learn how consumers such as themselves learned to play gaming devices, and that they would be paid depending on their performance in the game. There was a show-up fee of $5 (US), and subjects could earn up to $10 more depending on their scoring.

Subjects played the "Catch'em" game a total of 30 times, with the first 15 being practice rounds that didnot count toward their final earnings, and the second 15 being money rounds on which pay was based. Subjects were randomly assigned to one of six experimental cells of a 2*2(2) nested factorial design that varied three experimental factors:

1. Whether or not an enhanced game platform was made available to players after their training rounds (the latter being a control);
2. Ease of learning the control provided by the basic platform (button controls were easy to learn, scroll bars more difficult); and
3. For those with button controls, its asymptotic scoring potential (high or low), implemented by varying keystroke reliability[2].

[2] We did not manipulate reliability of the scroll-bar control because of its inherently slow rate of learning; under low reliability few subjects would have been able to discern whether low scores were accruing the difficulty of learning how to use the controls versus inherent unreliability—a distinction that would have been easier to make for the buttons, use was quickly deciphered.

The opportunity to purchase the new platform was offered only once; if a subject declined the purchase he or she played the 15 money rounds with the same game platform that they trained on, the same as those in the control condition

To insure that respondents in all conditions had a common sense for what constituted "good" versus "poor" performance from a control, they were instructed that better players should be able to avoid capture and earn 70 or more points per game, which was the average scoring level pilot subjects who used high-reliability buttons or scroll bars tended to achieve by the end of the training period. Hence, subjects endowed with either of those controls would have entered the buying decision believing they had already achieved reasonably high scoring levels playing with their existing platform (thus had a diminished normative incentive to buy a new one), while those with low-reliability buttons—whose training scores tended to be, on average, 30% lower—would have entered the decision with believing they had a achieved a relatively low level (thus had an enhanced incentive).

The new-generation platform. The central interest in the experiment was how subjects in the treatment groups responded to the opportunity to play their money rounds of the game with a new platform that offered an expanded set of controls. The version--the *combo platform*—provided subjects with access to *both* sets of controls that appeared in the basic platforms: buttons as well as scroll bars (Figure 1c).   Note that since subjects trained on only one kind of control and were unaware of the existence of the other, the added controls that appeared on the combo version represented an innovation: the scroll bars would have been novel to those who trained on buttons, and the buttons novel to those who trained on scroll bars[3].

[3] For subjects who trained on the scroll bar, the button controls on the combo platform were set to be of moderate reliability.

To minimize possible aesthetic motivations to acquire the new device the physical appearance of the combo platform was identical to that of each of the basic platforms with the exception of the presence of a second set of controls (Figure 1c). Likewise, subjects were advised that in the new platform the function and reliability of the more familiar controls was identical to that of their old platform.

The pricing and purchase mechanism. After completing the training phase of the game subjects in the control groups began playing for money, while those in the treatment groups read a mock news announcement that a new version had been developed (the combo platform) which they had the opportunity to purchase for play rather than the platform they trained on. Subjects were given an illustration of the combo platform (Figure 1c) but were not permitted to actually utilize it. It was emphasized that the more familiar controls on the new platform would function just the old ones did, and no statement was made about whether the availability of the new controls would allow them to realize better game scores than they would realize by continuing to play with their original platform.

After reading this announcement subjects were then told that they could acquire the combo device by paying a point handicap that would be applied to their realized score in the money round. Before being shown what this price would be, however, they would have to indicate the maximum price that they would be willing to pay for the game, and they will obtain it if the actual price turns out to be less than this value—an elicitation procedure akin to that suggested by Becker, de Groot, and Marschak (1964). To insure that subjects fully understood how the process would work subjects first participated in a practice round where they set a *WTP* price and an illustrative actual price was drawn by lottery. Subjects were given the opportunity to repeat this exercise until they felt comfortable with the procedure.

The actual price of the combo game was held constant for all subjects at 120 points, a price at which subjects would break even if the new game allowed them to realize a modest (8 point-per-game) increase in performance over the incumbent platform. After subjects submitted *WTP*s, those who submitted valuations greater than 120 were informed that they would be playing with the combo platform, and this the purchase price was immediately reflected as a negative number in the cumulative score box on their game screen.

Results

Manipulation checks. An analysis of the average performance attained by subjects using each of these control formats during the training rounds reaffirmed the findings from pilot work about their respective speeds of learning and asymptotic scores. Subjects using scroll bars, for example, realized an average score of 32 points over the first three training rounds, but this increased over time to a maximum of 78 points over the last three rounds. The high-reliability buttons, in contrast, yielded high performance throughout, with yielding a mean score of 51 on the first three rounds increasing to a maximum of 80, comparable to the best achieved by the scroll bars. Finally, the low-reliability buttons yielded comparatively poor performance throughout; respondents realized an average score of 27 points in the first three rounds, but with subsequent mean scores never exceeding 50.

The nature and efficiency of adoption decisions Among the 68 subjects in the treatment conditions who were given the opportunity to purchase the new game platform, 57 (84%) provided willingness-to-pay levels that were sufficient to attain ownership of the combo platform, with a mean *WTP* over all subjects of 341 points (median=300), with successful adopters expressing a mean *WTP* of 401 points (median=375). Hence, on the whole subjects were optimistic about the score improvement they could potentially realize by playing the new version. A subsequent analysis of the performance of the 11 non-adopters during the money rounds revealed a pattern of achievement similar to that observed among those in the control condition, hence these two groups were pooled in subsequent analyses.

The central focus of the analysis was the degree to which these optimistic assessments could be viewed as rational in terms of the subjects' subsequent utilization of the new controls and their realized rewards. We analyze this from two perspectives: whether subjects expressions of *WTP* were consistent with the scoring gains they actually realizing by adopting the combo platform, and whether they were consistent with the degree to which the new control offered by this platform was utilized after adoption.

In Figure 2 we plot the mean *WTP* of subjects who adopted the innovation by training condition relative to two standards of achievement: the cumulative improvement in scores they actually realized relative to that realized during the training rounds, and the cumulative improvement relative to the scores realized by control subjects who did not upgrade. The figure yields two insights:

1. *Supporting **H1**, excessive mean optimism in the projected benefits a new control*. As we previously noted, the mean stated *WTP* for the new platform among adopters across training conditions was 401 game points, equivalent to an expectation that having access to a second control would yield a 19% score improvement over that which would be realized by the basic platform. These implicit forecasts, however, turned out to excessively optimistic: the average score improvement realized by adopters over the training rounds was129 points *lower* on average than that achieved by those who never upgraded. In addition, the average *WTP* also exceeded the simple improvement in scores the adopters themselves realized relative to the training rounds

by an average 90 points. Hence, considering that the cost of the new platform was 120 game points, for most players the decision to adopt resulted in a net loss of game points relative to what they would have earned had they never upgraded..

2. *The optimism bias was conditioned by the training platform.* By visual inspection, Figures 2 also offers some initial support to ***H2***. The highest *WTP* (424 points) was generated by those adopters who had the most positive experiences with their initial control: those endowed with high-reliability buttons for which there was a fast learning curve. But these same subjects were also the ones who realized the greatest deficit in cumulative scoring relative to that realized by those who never adopted (242 points lower), and one of the lowest simple net improvements over their training-round scores (206 points, compared to 193 points for adopters who trained on unreliable buttons and 532 points for those who trained on scroll-bars).

A dynamic view of these findings is provided in Figure 3, which plots performance over all 30 trials for treatment versus control subjects by training condition. The figure suggests one contributing explanation for the exaggerated *WTP* estimates: while subjects who bought the new platform seem to have correctly anticipated that their performance would improve during the money trials playing with the new platform, they appeared overlook the fact that there would also be improvements in skill levels playing with the basic platform. The skill improvement displayed by non-adopters was often comparable to that achieved by adopters—but without incurring the new-product replacement cost. In short, it is as if the *WTP* estimates reflected an optimistic comparison of an envisioned future scoring value of the combo platform with the *current* value of the basic platform—a comparison that naively overlooked the fact that the future scoring value of the current platform would also likely be higher.

To more rigorously explore ***H2*** we modeled variation in cumulative scores during the money rounds as a function of expressed willingness to pay for the combo platform plus two controls for skill: score during the training rounds and gender. The results of this analysis, reported in Table 1, supported the hypothesized negative effect of willingness to pay on subsequent performance: those who offered the most optimistic assessments of the value of the new control—across training platforms--realized the lowest benefits of it after adoption ($t(1,64)= -3.53$; p=.0008). In short, contrary to the normative prediction that higher willingness to pay should foretell higher realized utility, here we observe a systematic *opposite* relationship between the two constructs.

Feature utilization. The evidence that subjects systematically overvalued the new platform rejects a hypothesis that they held accurate expectations about the incremental scoring benefits the new platform would provide. But this fact alone does not imply that the valuations were necessarily irrational; since none of the respondents had experience in tasks like this before, few would have had a statistical basis for forming a rational expectation about the likely performance of the new control. Hence, one might conjecture that it was simply a case of respondents, *en masse*, having overly optimistic beliefs about the benefits of the new controls. They assumed ownership with the good-faith belief that the new features will allow them to realize much higher scores, and simply discovered that the incremental benefit they offered was limited. If this were the case, we should evidence for it in how subjects utilized the new control over time; should observe high levels of experimental utilization on early trials, followed by diminished use in the cases where it provided no real net benefit (the high-reliability button and scroll-bar conditions) and sustained high use in cases where it provided a real benefit (low-reliability buttons).

Did adopters, in fact, make a rational effort to learn about the new controls when they were first acquired? The surprising answer seems to be "no". In Figure 4 we plots histograms of rates of usage of unfamiliar controls over the first three games in the money rounds (left panels) and over all 15 games (right panels). The data would appear to reject suggestions that subjects were fully utilizing their ability to learn about the value of the new controls. During the initial three games of the money rounds, when utilization of the novel control should rationally have been quite high, subjects who had trained on the high-reliability buttons (4a) and the scroll bar (4b) utilized the new (reciprocal) control only an average of 20% of the time, with a mode at 0%. This level of use then declined thereafter, with a majority of subjects focusing exclusive use on the control with which they had originally trained—be it the high-reliability button (4c) or the scroll bar (4d). In addition—and perhaps most disturbingly—there were 8 subjects in these two conditions who *never* utilized the new controls at all over the entire 15 games. In short, if respondents in these two conditions adopted the new platform with the intention to learn about its new features, it was an intention that was quickly abandoned after ownership.

Perhaps more compelling evidence against a hypothesis of normative learning is found in the usage rates of scroll bars by those subjects who trained on low-reliability buttons (Figures 4d and 4e). On one hand, unlike those who had positive experiences in the training rounds, here we see subjects displaying a much higher willingness to experiment with the new control during the first three games. The mean usage rate was 54%, with a mode between 60 and 70%. But this level is still well below that which one might expect of subjects were active experimenters—particularly in light of the poor level of performance afforded by their incumbent control. Indeed, paradoxically 4 subjects never tried using the scroll bar at all during the first three games, despite having paid for the opportunity to use it. Over subsequent trials learning eventually did appear to occur, but subjects ended up being equally split on which control was the better; about half correctly concluded that the scroll offered high scoring potential, and began using it over 80% of the time (Figure 4e). Another half, however, incorrectly concluded that it offered no advantages, and reverted to using the low-reliability button over 80% of the time.

As a final analysis we further examined evidence for ***H2***, the hypothesis that the overvaluation bias would be most acute among adopters with the highest valuations. To test this, we modeled the proportion of uses of the novel control for each subject over games as a function of the log of their stated willingness-to-pay for the combo platform, game trial, and initial training platform (Table 2). The results support the hypothesized negative relationship between attribute usage and optimism: increases in willingness to was associated with decreases in subsequent usage (β=-.114, p<.001), implying that rather than serving to foster new attribute usage, high valuations acted to suppress it.

Experiment 2

Motivation and Description

Experiment 1 offered evidence that initial valuations of the new-generation game platform did not relate to subsequent usage patterns as normative theory would prescribe. If respondents' willingness-to-pay assessments were unbiased forecasts of the likely value they would get from being able to use the new control, they were forecasts that seemed to be quickly forgotten after ownership was assumed. Respondents took only limited advantage of the opportunity to learn about its capabilities, and, paradoxically, those with the most optimistic implicit priors were those who displayed the most limited levels of use (***H2***). Partly as a result, respondents' willingness to pay for the platform far exceeded the gains they actually realized from adopting it, supporting our central hypothesis (***H1***)

Yet, the evidence remains circumstantial. It could still have been the case that when forming their initial assessments of value respondents *were* trying to look ahead to predict what the likely benefits of the new device might be, but they were simply too optimistic, and then were poor Bayesians after adoption, abandoning usage too soon.

To test whether the high initial valuations emerged from biased forecasts, ninety new subjects were recruited to participate in a variation of the experimental task where forecasts of likely usage rates and scores were obtained prior to making adoption decisions. Note that by intervening with such measures we were potentially introducing a significant psychological change to the task: that of priming the salience of beliefs about objective future value of the new platform just before the adoption decision was made. We anticipated that this priming might serve to mollify the overvaluation bias observed in the first task by making the relationship that *should* exist between beliefs about the future and valuations more transparent to subjects. Hence, this analysis could be seen as measuring the upper bound of the strength of the relationship between forecasts and willingness-to-pay that might be expected to naturally exist in un-intrusive task settings.

As in Experiment 1, subjects were randomly assigned to one of three basic platforms on which they first played 15 training games. In this case, however, we did not run a parallel set of no-upgrade control conditions; since our focus was on forecasts of the future value of the new platform, all subjects were given the opportunity to learn about and decide whether they wished to adopt it.

After subjects read the description of the new combo platform and before the elicitation of their willingness-to-pay, each was posed with a series of questions designed to tap their beliefs of the likely future value of the new platform. Subjects were asked to make five forecasts:

1. The likely number of trials need they would need to learn the true value of the new control;
2. The probability that the new platform, if adopted, would lead to an improved score compared to continued use of the old;
3. The final score they would earn if they played the money rounds with the new platform;
4. The final score they would earn if they played the money rounds with the incumbent platform; and
5. The percentage of time during the first three games of the money rounds that they would likely utilize the new control offered by the new platform (a measure of predicted experimental use when would it be normatively most worthwhile).

Results

Did asking subjects to provide explicit forecasts just before expressing willingness to pay mollify the overvaluation bias uncovered in Experiment 1? We found little evidence of such a diminishing effect. Mirroring the results of Experiment 1, subjects assigned high valuations to the combo platform, revealing a mean willingness to pay of 345 points over all three training platforms (compared to 341-points in Experiment 1), yielding a 75% adoption rate.(compared to 84% in Experiment 1). Likewise, these initial valuations also outstripped the average point gain adopters subsequently realized playing with the new platform, here to a even greater degree than was observed in the first experiment: adopters expressed a mean willingness to pay of 458 points for the new platform, but realized a cumulative point total in the money rounds that was, on average, 99 points (6%) *lower* than that which they earned during the practice rounds (as we will note below, a result primarily driven by particularly poor performance by adopters who trained on unreliable buttons) . Given that the new platform cost 120 points to acquire, the typical subject here, like in Experiment 1, lost in the upgrade transaction.

Where adoption behavior somewhat differed was in the effect of the training platform on adoption rates. Here the highest rate of adoption (86%) and highest expressions of willingness to pay (421 points overall; 520 points by adopters) was observed among those who would logically objectively benefit the most—those who trained on low-reliability buttons. In contrast, rates of adoption were lower among those who trained on either high-reliability buttons (70% adoption rate; *WTP*=308, 422 among adopters) or scroll bars (75% adoption rate; *WTP*=324, 416 among adopters). But the data revealed the same support for ***H2*** that we uncovered in Experiment 1: the highest-valuation group—here those who trained on low-reliability buttons--was also that which benefited the *least* by the adoption. Playing with the combo platform, subjects in this condition cumulatively earned *270 fewer* points (a 17% decrease) than they did in the training rounds, compared to a modest 63-point gain among those who trained on high-reliability buttons and a 43-point gain among those who trained on scroll bars (omnibus ($F(2,70)=5.24$, $p=.008$).

Did these persistent excessive valuations accrue to adopters having made overly-optimistic predictions about the future? We can test this possibility by analyzing the degree to which expressions of willingness to pay were systematically related to respondents' forecasts of the value of the new control offered by the enhanced platform, as defined by expected learning difficulty, overall relative scoring improvement, and expected frequency of use. If subjects' assessments of *WTP* accrued to overly optimistic downstream forecasts, we should see a strong monotonic relationship between *WTP* and predicted learning time for the new control and forecast scoring potential.

The data, however, strongly reject such a relationship. In Figure 5 we present scatter-plots of the relationship between willingness to pay and the forecasts respondents made about the difference between the predicted ending score using the new platform minus that using the incumbent (5a), the simple odds that it would offer improvement over the incumbent (5b), and the number of trails it would take to learn the new platform (5c). In none of these cases can we find support for a statistically significant monotonic relationship between downstream forecasts and upstream valuations. While the relationships between valuations and forecasts of net score improvement were, as they should be, directionally positive, the associations were quite weak *(4(a) r=.20; p(t)=.08; 4(b) r=.16; p(t)=.12)* and could not reject a null hypothesis of chance covariation. The association that was nominally the strongest was that between valuations and predicted learning duration, but the direction of the effect is nominally *positive* (*r=.21; p(t)=.07*)—the opposite of that prescribed by any options analysis.

The finding that respondents' valuations of ***WTP*** were not linked to forecasts of downstream benefits is perhaps most vividly illustrated by the judgments made by the thirty-eight respondents who predicted they would realize the ending score with the new platform as they would with the incumbent; i.e., those form whom there was predicted to be *no* downstream scoring advantage to the new generation Although the normative *WTP* for such respondents is 0, the mean actual *WTP* was 330 (ranging from 29 to 1000), with all but one subject adopting the new platform. What is particularly intriguing about this overvaluation is that the forecast of scoring benefit was made *before* the valuations were made—implying that no effort was made to align the valuations with even if just to maintain the appearance of consistency.

Finally, the data also reject a hypothesis that respondents adopted the new platform based on overly optimistic beliefs about the frequency with which they would utilize the new control.

When they were asked to forecast the percentage of time over the first 3 trials that they expected to use the new control (when normative theory prescribes that usage should be the highest) the mean prediction was 40.4%--which was not significantly different from the actual mean rate of utilization, 38.2%. Hence, subjects appeared neither overly optimistic about their likely usage of the control on early trials nor, apparently, fully aware of the normative principle that one *should* actively utilize it during such trials.

Experiment 3

Motivation and Description

The data from the second experiment appears to support the hypothesis that initial valuations of new generations are based on heuristics that attach a positive value to novelty and/or flexibility, but that do not explicitly consider likely downstream usage rates and objective returns. Intuition suggests, however, that excessive optimism would vanish if decision makers had more complete information about the real value of the new control, such as gleamed from a period of trial ownership. In ***H3,*** however, we hypothesized that this might not be the case, as the suppressing effect of direct experience might be offset by the enhancing effect of the decision maker either retaining an exaggerated preference for flexibility or feeling a sense of endowment toward the new controls.

To test this hypothesis we ran two final variants on the basic experimental paradigm. The first replicated the procedure of the first and second experiments but where thirty-three respondents were now allowed to play two practice games with the combo platform prior to making an adoption decision. This variation was run as an additional condition in the same experimental sessions that included Experiment 2, thereby permitting a direct comparison of adoption rates with those of a matching sample who did not have access to free trials. Due to limited subject resources we focused on the effect of trial on only one incumbent type of platform, that of high-reliability buttons. We focused on this platform because it represented the case where the new controls had the lowest rate of actual usage after adoption—hence where the knowledge gained by trial would be most valuable.

To provide a more extreme case of acquired knowledge, a separate group of 102 undergraduate business majors were recruited and randomly assigned to a variation of the task where we *reversed* the sequence of product ownership: we initially endowed subjects with the combo platform, and then offered them the opportunity to be *paid* for replacing it with a new generation that came with only with the one control that they found they used the most—be it either scroll bars or buttons[4].

Respondents' willingness to accept payment for exchanging the combo platform for a new simplified mode was elicited by a modified *BDM* procedure mirroring that used in Experiments 1 and 2. In this case the actual acceptance threshold was set at 300 points, slightly more than twice the threshold value used in the *WTP* lotteries in Experiments 1 and 2. This threshold was such as to compensate the average player for a 20% decrease in performance in the money rounds playing with a simplified platform---a highly generous level of compensation.

Note that this second manipulation also had the advantage of allowing us to test whether desires to own the new platform might simply accrue to a desire for a change of pace in platforms. If this were the case, we should see little effect of endowment in this task; respondents should be happy to accept compensation for exchanging the combo platform for a new one that carries only the one control they mainly use.

Results

[4] When training began with the combo platform 65% of subjects gravitated toward the buttons as their primary controls, while 35% gravitated toward the scroll-bars as their primary control.

The effect of trial ownership. Subjects who had the ability to play two trial games appeared to take full advantage of the opportunity it offered to learn about the effectiveness of the new scroll-bar control. The control was used 51% of the time on the first free trial, higher than the rate of observed among adopters who trained on the same (good button) platform on early trials that we reported in Experiment 1 (17%; Figure 4a), as well as Experiment 2 (31%, not previously reported). Moreover, this one trial appeared sufficient to allow these subjects to reach the same conclusion about the relative value of the scrollbar that the non-trial subjects did—namely that it was limited. On the second free trial average usage of the scroll bar dropped to 33% (*t(23)=-1.95; p=.06*), implying an earky end to experimentation.

Did this free knowledge translate to a lower willingness-to-pay for the combo platform? Paradoxically, it did not. If anything, having access to free trials induced a nominal *increase* in respondents' willingness to pay to adopt the innovation; those subjects in Experiment 2 who trained on high-reliability buttons (including adopters and non-adopters) revealed a mean *WTP* of 308 points (median 250), while those with free trials revealed a mean *WTP* of 320 (median 320) (t(54)=.18; p>.8). Correspondingly, subjects with access to the trials had a nominally higher adoption rate (79% vs. 70%)—though not one that statistically significant (χ^2 =.61; p=.40).

Further evidence that access to the free trials did little to mollify the overvaluation bias is the fact that those who chose to adopt after experiencing the free trials exhibited a statistically-significant *lower* rate of usage of the new control over all money rounds than adopters in Experiment 2 who did not have access to the trials (19% v. 25% over all trials; F(1,82)=5.51; p=.04). Likewise, there was no difference in the score improvement (scoring in the money rounds relative to the average of the last 3 training rounds) playing with the combo platform between those with access to free trials and those without *(81 v. 63; t(54)=.32, p>.7)*.

Reversing the sequence of ownership. This second experimental condition provided insights into valuation given more extreme durations of ownership, as wells well allowed as tests of whether preference for the combo platform might reflect a mere desire for a change of pace. To address these issues we analyzed the point supplements that subjects were willing to accept to trade the combo platform for a simplified one that contained just the controls that they indicated that they found most useful in the training rounds. While the opportunity of an exchange should have been quite attractive to such subjects, most set *WTA* prices that precluded successful transactions, revealing a mean WTA of 455 (median 500), leading to 31% successful trade-downs. Even more dramatically, even the 38 subjects who *never* used the control that was being eliminated displayed an aversion for playing with a simpler platform, revealing a mean *WTA* of 409 (median 455), an assessment that led to 39% successful transactions.

Hence, even in cases where subjects were fully aware that they likely would make limited use of a given control they still saw considerable value in retaining the *option* to use it. Just as subjects in the free-trial condition expressed an excessive willingness-to-pay for the ability to acquire the control, here subject demanded excessive compensation to give it up—even given fully knowledge of its (limited) value. In the same way that consumers have previously been found to be attracted to products that carry enriched--but functionally meaningless—attribute descriptions (e.g., Brown and Carpenter 2000), here find a similar attraction to supplemental tangible physical controls that, for many respondents, were found to be superfluous in use.

While the data from this final experiment does not provide a direct explanation for this bias, it would be consistent with a general tendency for individuals to place an exaggerated value on the mere ability to hold options—something reflected in the finding of exaggerated preferences for flexibility in search tasks reported by Shin and Ariely (2004). Moreover, such a heuristic preference may have been exacerbated in the trade-down by the effects if endowment; even though subjects knew that their less-used control held little value, the mere notion of exchanging more for what seemed like less was seen as aversive.

Discussion

The According to a 2003 *Harris Poll,* 45% of American cell phone owners have never used voice mail, and 50% have never exercised the option to set their phones to silent or vibrate. Yet, we suspect that few of these same decision makers would have considered buying a phone that did not have these functions. Although merely an anecdote, this illustrates an often-heard bias in consumer decisions to adopt new technologies: given the opportunity to purchase new generations of an existing product with more bells and whistles, consumers frequently display an eagerness to adopt that goes beyond that which could be reasonably justified by their later utilization of these features and the happiness they yield.

How real is this effect, and what is its psychological basis? The goal of this paper was to take a step toward gaining this knowledge by observing how a sample of individuals made decisions whether or not to buy a new technology—an improved gaming device—in a laboratory setting that allowed experimental control over the actual incremental value of the technology and permitted direct measurement of both upstream (pre-adoption) valuations and downstream (post-adoption) utilization.

Central to the work was a hypothesis that a general over-buying bias may, in fact, have a systematic cognitive basis. Drawing on prior work from a range of literatures in new-product responses and intuitive forecasting, we hypothesized that when buying new technologies initial valuations will be based on heuristics that involve little formal anticipation of how the new features of a product will be utilized after adoption, or the net increment in utility this usage will generate. The general bias will be toward seeing innovations as having positive benefits. In contrast, decisions about whether to *utilize* new features after adoption display little *memory* of these initial valuations, as actual utilization is suppressed by a tendency to avoid unfamiliar features when more familiar ones are available.

The experimental data reported here provide support for this view of new product valuation. In an initial study respondents displayed a high willingness to pay for a new game platform that offered access to a second control, but then engaged in limited utilization of it after adoption. Moreover, this tendency to under-utilize the new platform was, paradoxically, most pronounced among those adopters with the most optimistic prior valuations. A second study replicated these findings in a context where forecasts of downstream usage and performance were primed just before adoption decisions were made. Congruent with the conjectured basis of the findings of Experiment 1, these down stream forecasts were uncorrelated with expressions of willingness to pay. Finally, a third study established that allowing subjects to directly examine the comparative value of the controls during a period of trial ownership did little to mollify the overvaluation bias.

What is notable about the current demonstration is that it arose in a context designed to facilitate rational assessments of innovation value. Unlike previous demonstrations of "meaningless differentiation" effects (e.g., Carpenter, Glazer, and Nakamoto 1994), respondents here were given a clearly-stated metric by which the objective value of the innovation would be assessed, there was a direct monetary penalty for overstating value (the game innovation was paid for by a point deduction), and the innovation itself was a purely functional rather than aesthetic one (a new control added to the same graphic game platform). Yet, respondents still succumbed a bias we suggest may arise in real markets: a tendency to overvalue prospective innovations, and then under-utilize their features upon acquisition, even for the limited purposes of experimentation.

A further intriguing aspect of the results is that while these upgrade decisions proved to be ill-advised in terms of the benefits respondents actually realized from them, few seemed to regret it; there was no reciprocal rebate market for simplified platforms that allowed players access to just those controls they found most useful. Hence, respondents were apparently drawn to the enhanced platform not simply because of an (erroneous) calculation of expected benefits minus costs, but rather by a battery of affective forces that have a more limited rational basis, such as a desire to own top-of-the-line, and a pure preference for flexibility in control usage--even when never exploited.

Caveats

While the current findings offer support for the hypothesized effects of product enhancements, care must taken before presuming generalizability. First, a quite natural question is the effect of longer-term learning on the overvaluation bias. It is natural to argue that once a consumer recognizes that they have overbought a technology they will be less inclined to do the same the next time around. We speculate, for example, that our subjects would have been less enthusiastic about adopting a third generation that introduced yet a third set of controls—though such a reluctance might be more attributable to diminishing returns to enhancements (Nowlis and Simsonson 1996) rather than de-biasing. It may well be that subjects would again be prone to over-valuation if a different kind of enhancement was offered, such as and ability to change the game itself[5].

[5] Consistent with this notion, we gathered pilot data on a three-generation version of the current task where another enhancement was an ability to alter the platform's color. While subjects showed limited interest in a new generation that offered this feature, we found that interest in acquiring a new set of controls was robust to whether it was introduced in the second or third generation.

In this same vein, an interesting challenge for future work would be to identify situations where consumers might systematically *undervalue* attribute innovations. Work by Mukherjee and Hoyer (2001) suggest one such boundary condition. They offer data showing that when an underlying product already has a complex structure adding yet more features—making it seem even more complex--can degrade attractiveness by increasing perceived learning and usage costs. Hence, there is almost certainly an upper limit to the enhancement effect documented here. But what is unclear in such ideas is whether pessimistic prior assessments might then be followed by *higher* levels of usage than were initially envisioned. One mechanism might be that in these settings pessimistic expectations about the cost of using new attributes might cause consumers to see complex attributes in a positive light—something that would reverse an underutilization bias.

Finally, an important goal of future work will be to more thoroughly resolve the psychological mechanisms that underlie consumer assessments of novel attributes. In the current work we hypothesized that initial valuations of attribute innovations will be driven by heuristics that do not explicitly—or accurately--forecast downstream utilization. The work is silent, however, on how these heuristics are formed, and how they might vary across contexts. For example, we argued here that respondents' optimistic judgments were rooted in both the conversational norm that new features tend to be beneficial, and innate preferences for options that offer flexibility (Shin and Ariely 2004). But the exact inferences that consumers will form for specific innovations will clearly vary widely, depending on such things as the pattern of analogies that a new product feature triggers (e.g., Moreau, Lehmann, and Markham 2001). An important line of future research is to further explore these micro processes in an effort to better define the boundary conditions of the kind valuation biases.

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Table 1 Effect of willingness to pay on scoring in money rounds

Dependent variable: Cumulative performance during money rounds

Variable	Parameter Estimate	SE	t value	Pr > |t|
Intercept	1482.25	360.57	4.11	0.0001
Cumulative performance during training rounds	0.95	0.95	7.40	<.0001
Gender*	-387.87	136.85	-2.83	0.0061
Log(WTP)	-159.45	45.21	-3.53	0.0008

$F(3,63)=28.84$; $p<.0001$
Adj. R-sq = 0.55

* 1=Female and 0=Male

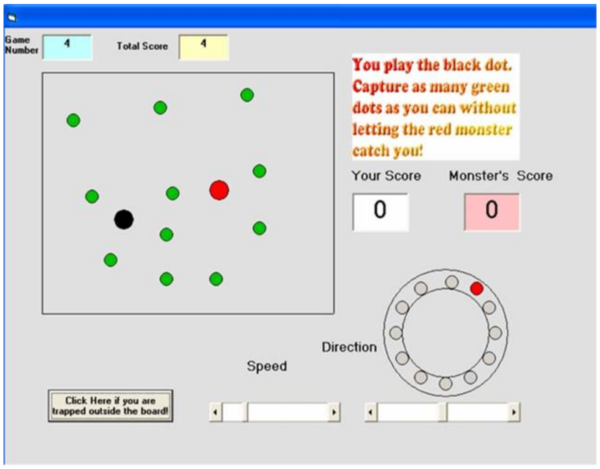
Table 2: Effect of willingness to pay on novel attribute utilization

Criterion: % usage of new control				
Predictor		Parameter Estimate	t-value	Pr > |t|
Intercept		0.915	6.18	<.0001
Initial platform				
	Bad buttons	0.354	11.81	<.0001
	Good buttons	-0.104	-3.39	0.0007
Log(WTP)		-0.114	-5.09	<.0001
Game trial		-0.003	-0.93	0.3531
Game trial^2		0.001	1.11	0.2693

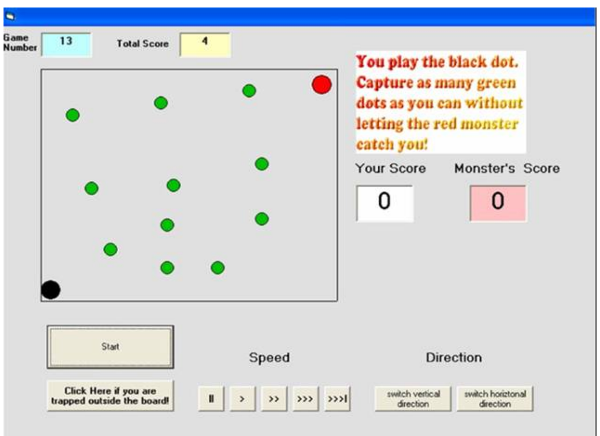
$F(5, 849) = 62.52$, $p<.0001$

Adj. R-sq = 0.27

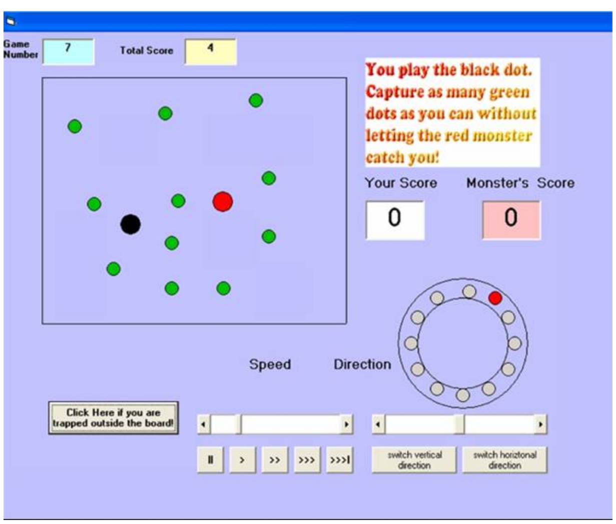
Figure 1: The Three Game Platforms



1a: Scroll-Bar Control



1b: Button Control



1c: The Enhanced Platform: Combined Controls

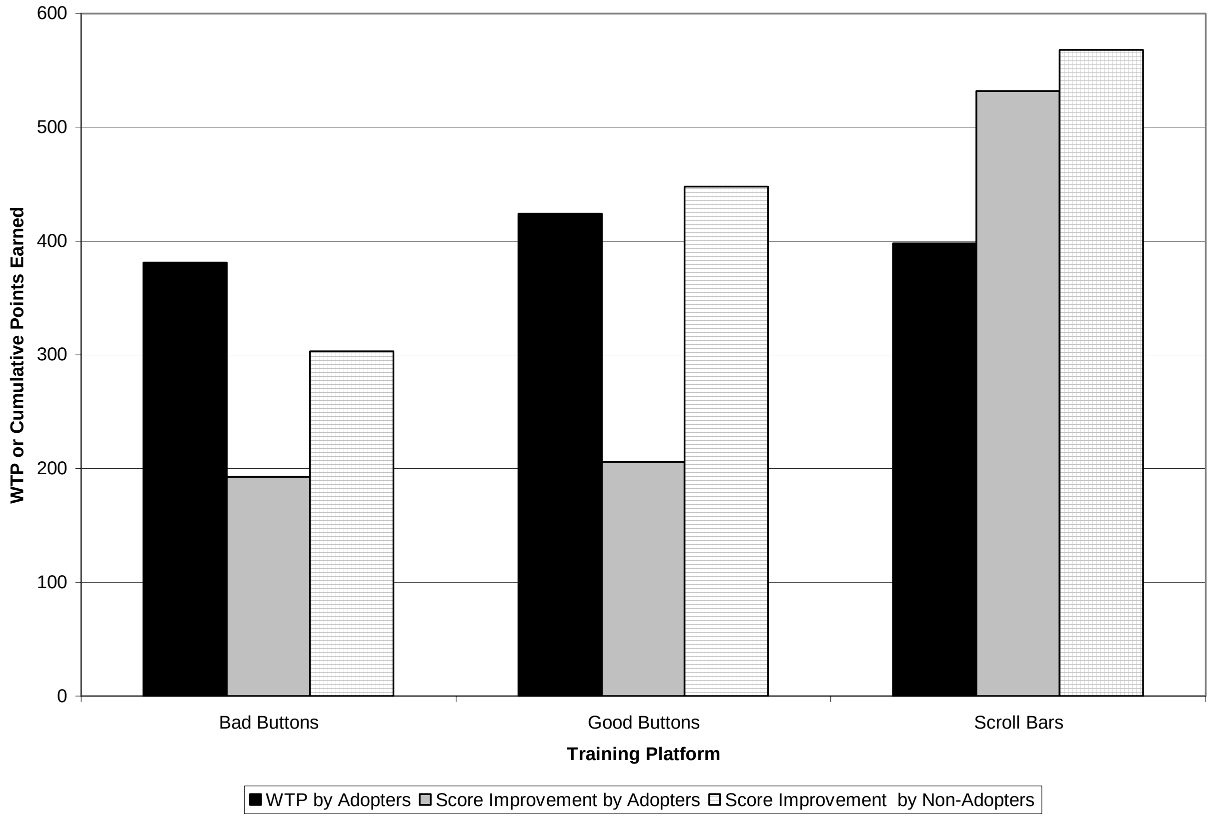


Figure 2: Willingness to Pay (WTP) by adopters and cumulative improvement in scoring between money and training rounds by adopters and non-adopters (control)

Figure 3: Performance over time by initial platform and upgrade decision

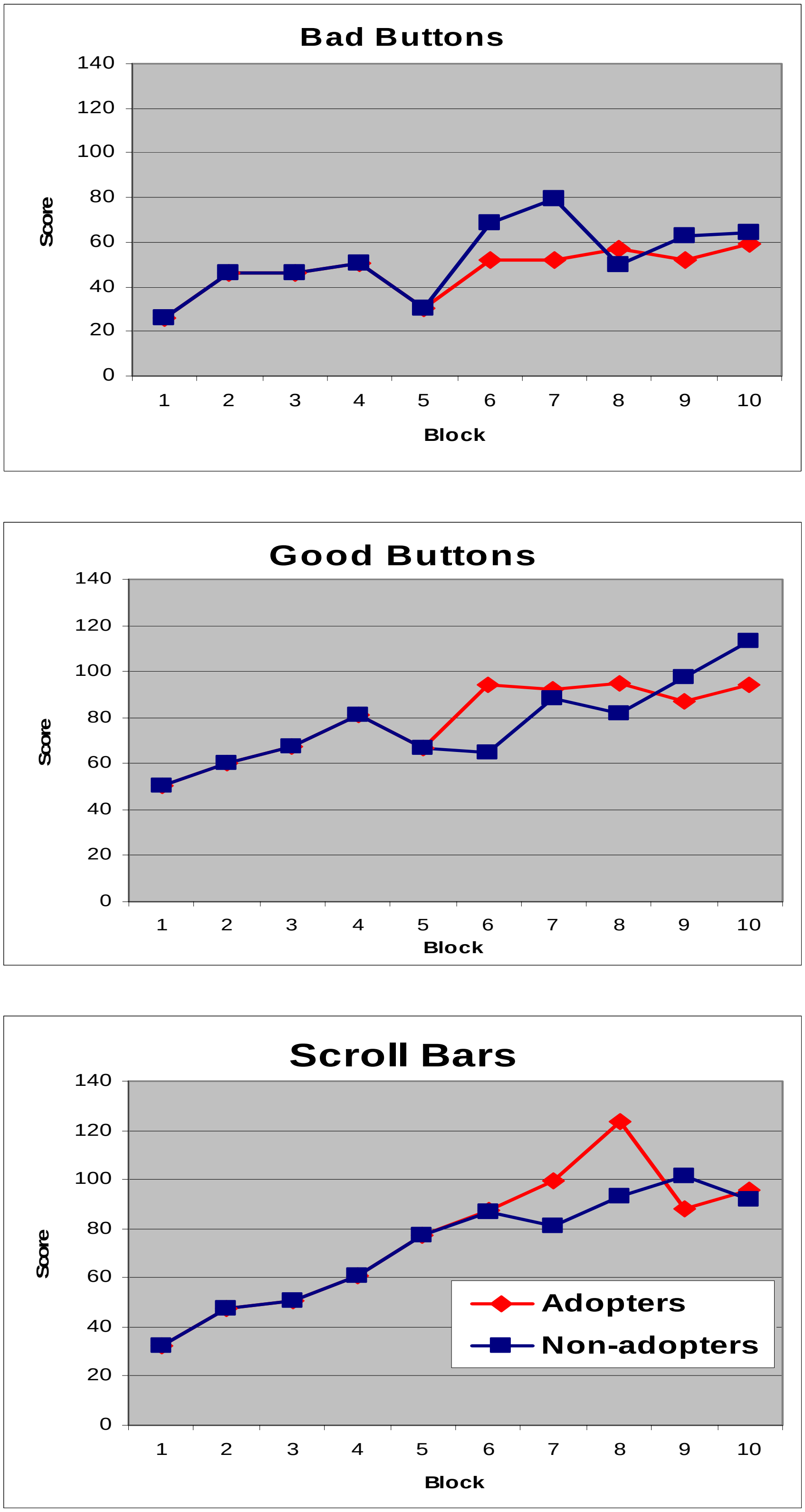
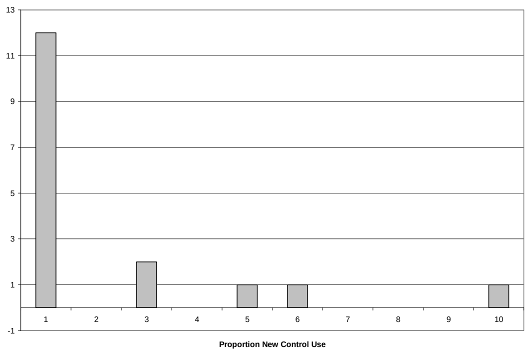
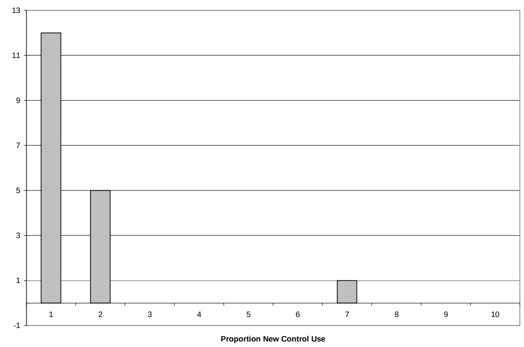


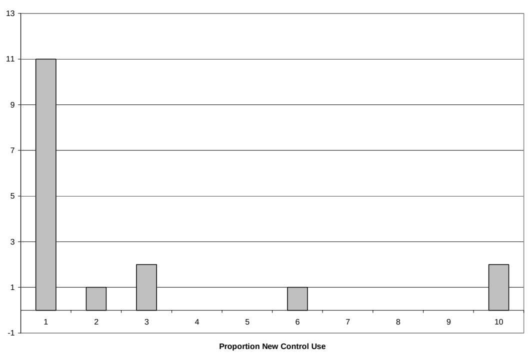
Figure 4: Histograms of utilization of unfamiliar controls on first three and all game trials by initial platform



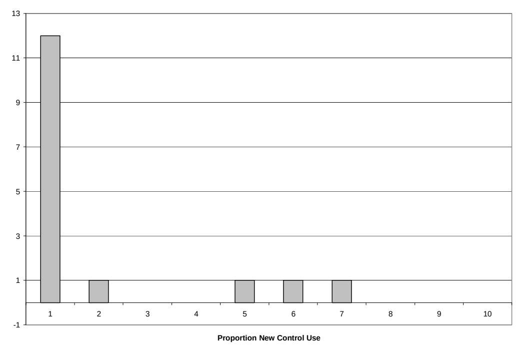
4a. Trials 1-3, Training=Good Buttons;
Mean usage=17%



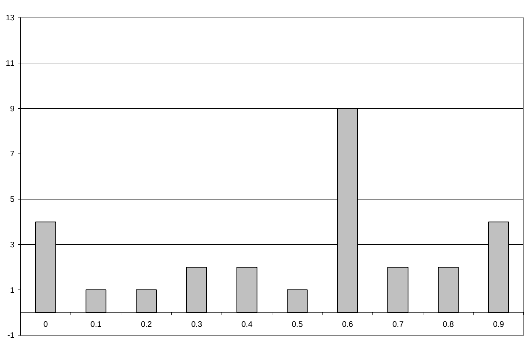
4b. Trails 1-15 Training=Good Buttons
Mean Usage=8%



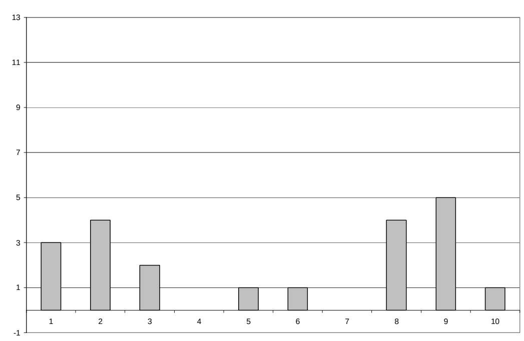
4c. Trials 1-3, Training=Scroll Bars
Mean Usage=22%



4d. Trials 1-15, Training=Scroll Bars
Mean Usage=17%

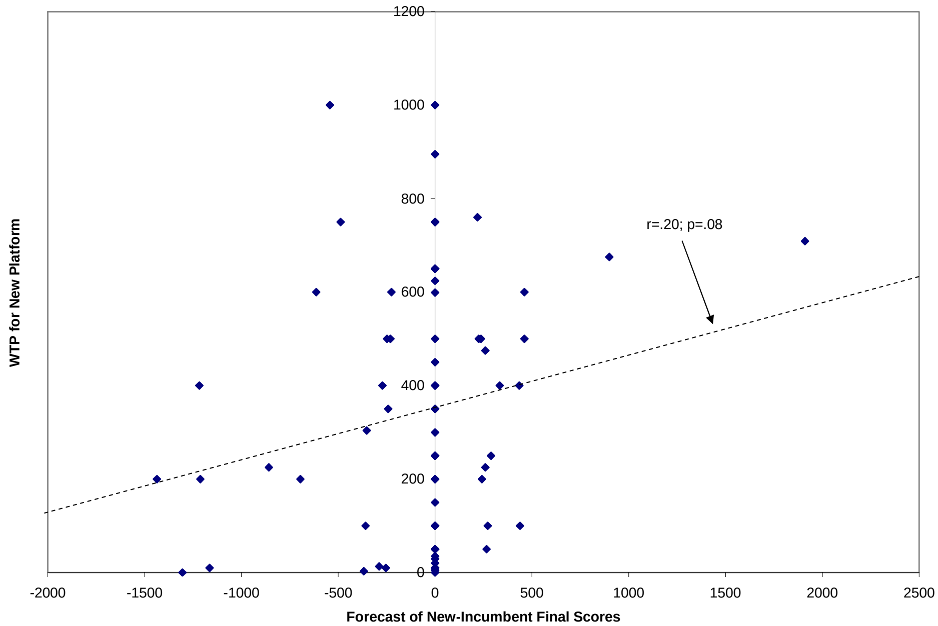


4e. Trials 1-3, Training=Bad Buttons
Mean Usage=53%

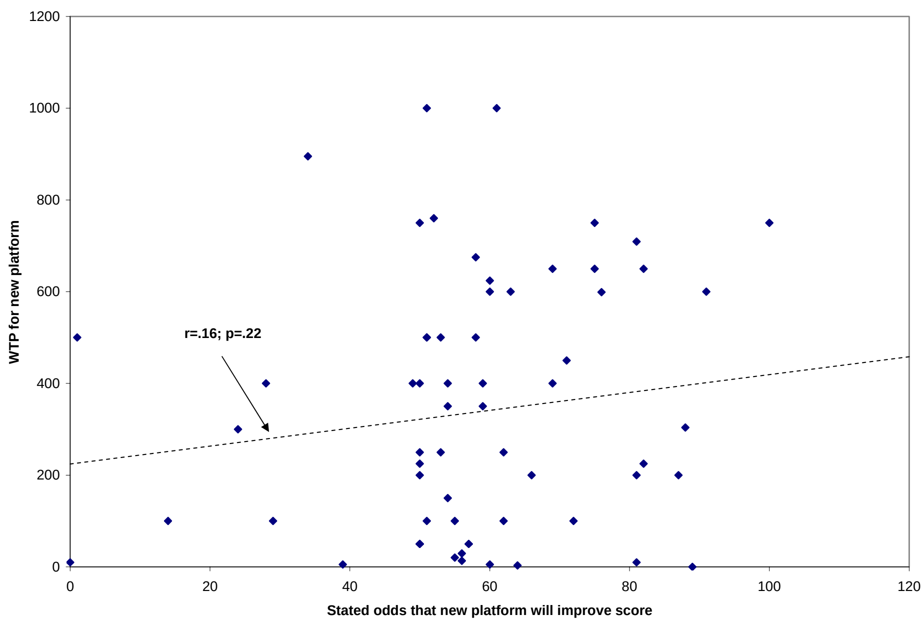


4f. Trials 1-15, Training=Good Buttons
Mean Usage=55%

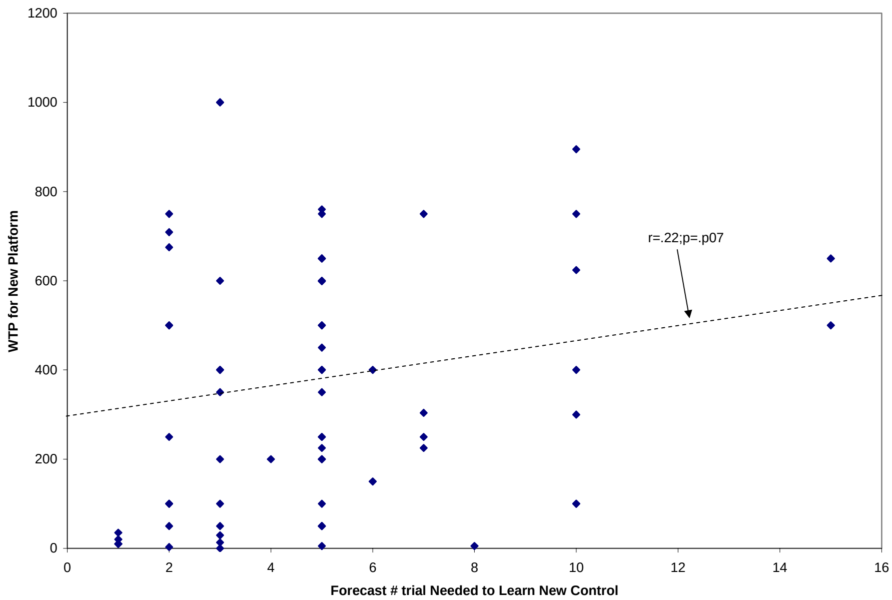
Figure 5: Scatter-plots of WTP for the new platform as a function of forecast scores and learning difficulty, Experiment 2



5a. WTP by the difference between subjects' forecasts of their final score playing with the new platform minus that playing with their incumbent platform



5b. WTP by the subjects' estimates of the probability that the new platform would allow an improvement in scores



5c. WTP by number of predicted number of trials need to learn the new control