Virtual Progress: The Effect of Path Characteristics on Perceptions of Progress and Choice

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In goal-oriented services, consumers want to get transported from one well-defined state (start) to another (destination) state without much concern for intermediate states. A cost-based evaluation of such services should depend on the total cost associated with the service—i.e., the price and the amount of time taken for completion. In this paper, we demonstrate that the characteristics of the path to the final destination also influence evaluation and choice. Specifically, we show that segments of idle time and travel away from the final destination are seen as obstacles in the progress towards the destination, and hence lower the choice likelihood of the path. Further, we show that the earlier such obstacles occur during the service, the lower is the choice likelihood. We present an analytical model of consumer choice and test its predictions in a series of experiments. Our results show that in choosing between two services that cover the same displacement in the same time (i.e., identical average progress), consumer choice is driven by the perception of progress towards the goal (i.e., by *virtual* progress). In a final experiment, we show that the effects of virtual progress may outweigh the effects of actual average progress.
(*Goal-Oriented Services; Behavioral Decision Making; Progress; Choice; Path Characteristics; Transportation*)

Introduction

In many service situations, consumers are transported from one state to another over a certain interval of time. For example, an airline may transport passengers from Denver to Boston over four hours, or a supplier of machine tools may undertake to deliver and install a new assembly line of 80 machine tools over 20 weeks. In both cases, the service moves the consumer (the passenger, or the assembly line) from a *start state* (Denver, or the absence of the assembly line) to a *destination state* (Boston, or the existence of a new line) over a specified period of time (four hours, or 20 weeks, respectively; we refer to this as the *elapsed time*). In these services, the goal of the consumer is to attain the destination state without much regard to the intermediate states.

Given their goal-oriented nature, the most basic evaluation of such services might use a total cost approach in which the evaluation is a function of the cost of time involved (i.e., a function of elapsed time, Becker 1965) and any additional costs incurred. These additional costs could be monetary (i.e., the price paid) or nonmonetary (e.g., the hassle of changing planes). Consumers should be indifferent between services in which each element of cost is held constant. However, we argue in this paper that in addition to cost factors like the elapsed time and price, the evaluation of services is influenced by the path characteristics of the service. Specifically, certain path

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characteristics convey a greater perceived progress towards the destination, and a belief that the elapsed time is utilized efficiently. This perceived progress towards the destination represents an additional variable that influences consumer choice.

Note that the comparison of two paths in which an identical output (i.e., distance traveled or number of machines installed) is produced in an identical elapsed time might lead to a conclusion that the mathematical rate of progress, as viewed over the entire path, is identical (cf. Allen 1997). However, we propose that the perceived progress as experienced during the path also influences consumer judgment and decision making. We use the term virtual progress to capture this perception of progress. It is not our intention to argue that the effects of virtual progress are either unreal or irrational; we simply use the word "virtual" to capture a source of progress that may not be immediately obvious from a simple mathematical representation of the service situation.

In the rest of this paper, we first review relevant literature, present an analytical model of consumer choice, and derive predictions about specific relationships between path characteristics and choice. Second, we present the results of six experiments designed to test these predictions and to highlight the importance of virtual progress. The first five experiments study choices between services in which the elapsed time and price is held constant, but in which the path characteristics vary. In a final experiment, we show that virtual progress is not merely an artifactual phenomenon that only comes into prominence when elapsed time is held constant, but that consumers are actually willing to choose longer paths that have a higher degree of perceived progress. Finally, we conclude with a general discussion and propose directions for future research.

The Effect of Path Characteristics on Evaluations—A Model of Consumer Choice

Recent research in behavioral decision making suggests that sequences of events create consumer experiences (Ariely 1998, Ariely and Carmon 2000, Carmon and Kahneman 1996). Research has also shown that the evaluation of such experiences is not greatly influenced by the actual duration of the experience (Fredrickson and Kahneman 1993) or by the final outcome (Hsee and Abelson 1991), but rather by some defining features or gestalt characteristics of the experiences (Ariely and Carmon 2000, Kahneman et al. 1993). These features include the relative value of the outcome as compared to its past values (Loewenstein and Prelec 1993), the rate of change of the outcome (Hsee and Abelson 1991), the peak intensity of the experience (Ariely 1998), and the affective experience at the end of the sequence (Ariely and Carmon 2000).

We identify another path characteristic that is especially relevant for goal-oriented services—the perceived progress towards the destination. Prior research suggests that the achievement of subtasks towards the attainment of a goal often signals a sense of progress that contributes to feelings of well-being and high morale in individuals (Brunstein 1993, Cantor and Kihlstrom 1987). Theories of motivation (Deci and Ryan 1985) suggest that people like to be in situations in which they are constantly making progress towards their goal, and further, that progress enhances psychological well-being (Sheldon and Kasser 1995, 1998). This suggests that in situations where consumers are focussed on the goal of reaching the destination, they actively choose activities that will help them attain this goal (Locke and Latham 1990, Sheldon and Kasser 1998).

Modeling Consumer Choice

We first consider service alternatives that have identical prices, and start (O) and destination (D) locations. The elapsed time T represents the time needed to traverse this distance. We represent the opportunity costs of elapsed time T as $c(T)$ where $c'(T) > 0$ (Becker 1965, Soman 2001).

We next incorporate the effects of perceived progress. We characterize a service path as a series of velocities $\{v_t,\ t \in [0, T]\}$ where velocity v_t is a measure of the *progress* towards destination at any given time t. Velocity v_t can represent the speed of airplanes, the rate at which machine tools are delivered, or the rate of change in a patient's blood glucose level, and it can be positive, zero, or negative. A positive velocity transports the consumer closer to the destination (resulting in *positive displacement*), zero velocity keeps the consumer at the same location (*idle period*), and a negative velocity (a flight traveling in the opposite direction) moves the consumer away from the destination (*negative displacement*).[1]

Prior research shows that people anticipate utilities from future events (cf. Elster and Loewenstein 1992). Specifically, we propose that consumers evaluating a path anticipate gaining some value $u(v_t)$ from the velocity v_t at any time t, and that this value is a function of the difference between the actual velocity and a reference velocity (Loewenstein and Prelec 1993). Further, research has shown that future outcomes have a lower impact than current outcomes because people tend to undervalue—or discount—the future (Liberman and Trope 1998, Rachlin and Raineri 1992). We capture this by a discounting function such that $u_0(v_t)$, the present anticipated value arising from time t, equals $u(v_t)\delta^t$ ($\delta =$ discounting factor, $0 \leq \delta \leq 1$). When $\delta = 1$, there is no discounting and future outcomes carry as much weight as present outcomes, and when $\delta = 0$, future outcomes play no role and only the current outcome matters. Recent research infers implicit discount rates for the decision weights associated with delayed attributes and suggests that typical values of δ are in the range of 0.8–0.95 (see Loewenstein and Prelec 1992). Generally, it appears that individuals care about future events, but undervalue these future events relative to the present (Soman 2002).

We further propose that values are generated for each instant during the service and that the valuation of the entire service (U) is the simple aggregation of such values plus a negative value associated with the length of the elapsed time. We use the notation "U" rather than "V" to represent value to avoid confusion with the notation for velocity. Therefore, the predicted value is

$$U = \int_0^T u(v_t)\delta^t \, dt - c(T). \tag{1}$$

Note that service valuation also decreases with the elapsed time T. Equation (1) represents our basic model of consumer decision making.[2]

Anticipated Value from Progress

We model the anticipated value arising from the perceived progress towards destination through the deviation of a service route from the consumer's expected progress over time. A rich literature has documented that utility (or value) of an outcome is evaluated with reference to some underlying expected level of that outcome (e.g., Kahneman and Tversky 1979). In this spirit, we argue that a consumer would obtain a positive value when progressing faster than expected, but receive a negative value when moving slower than expected. Let R_t be the expected rate of progress at time t. We propose that this is a constant; i.e. $R_t = \tilde{v}$ where $t \in [0, T]$. This is consistent with Loewenstein and Prelec (1993), who suggest that consumers develop their reference based on a uniform path from start to destination state (i.e., $\tilde{v} = \bar{v} = D/T$). We also validate this assumption using a series of verbal protocols where subjects were asked to think aloud as they evaluated a number of services with different path characteristics. One of the most prominent themes that emerged from this analysis was a tendency to start the evaluation by computing the average velocity (see also Flint 1998). Even when evaluating a path singly, subjects tended to compare it with some internally generated "control" path of uniform velocity. Thus, while we do not impose restrictions on the value of $\tilde{v}$, past research and our protocol analysis suggest that $\bar{v}$ is a good approximation for $\tilde{v}$.

[1] In this paper, we consider situations where consumers focus on the goal of reaching the destination. As a result, the velocity is a one-dimension vector that measures the progress to the goal. In service situations where consumers have multiple goals, the velocity becomes a multiple-dimension vector, with each element of the vector measuring the progress to the corresponding goal. The valuation of the service will be an additive measure of the valuation of progress to individual goals. We thank a reviewer for pointing out this model extension.

[2] The effect of path characteristics that we study is independent of the opportunity cost of time, $c(T)$. Therefore, we leave the cost function $c(T)$ in a general form without imposing any restrictions on its specification, e.g., whether $c(T)$ should be a function of the discount factor.

Let $g(\cdot)$ and $l(\cdot)$ represent gain (velocity greater than reference) and loss (velocity less than reference) function, respectively. Then,

$$g(v_t) = \frac{|v_t - \tilde{v}| + (v_t - \tilde{v})}{2}, \tag{2}$$

$$l(v_t) = \frac{|v_t - \tilde{v}| - (v_t - \tilde{v})}{2}. \tag{3}$$

If a consumer has a gain, then loss $l(v_t) = 0$. Similarly, if he experiences a loss, then $g(v_t) = 0$. We can then write a consumer's predicted value from velocity v_t as

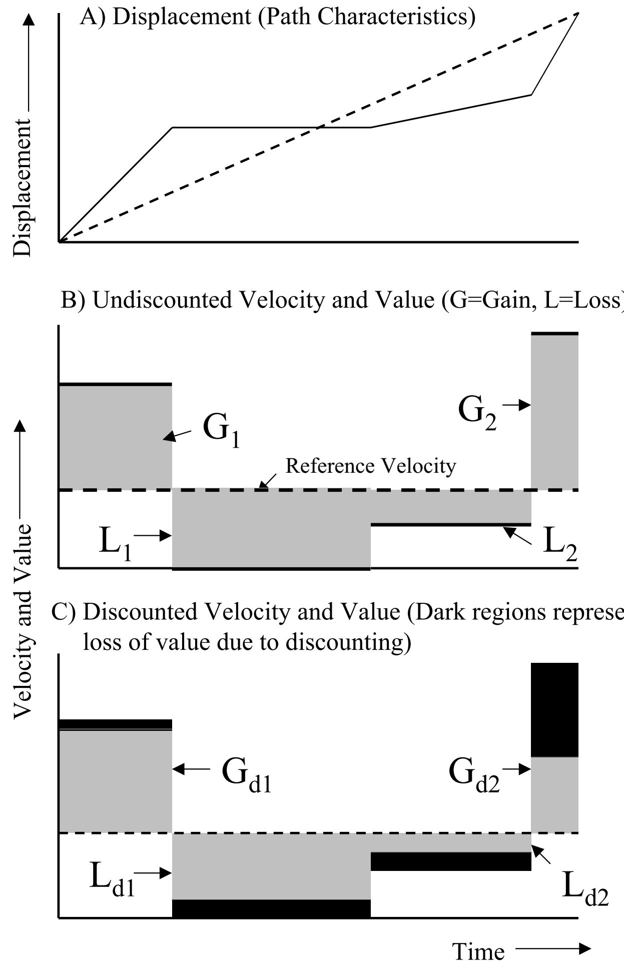
$$u(v_t) = \begin{cases} g(v_t) & \text{if } v_t \geq \tilde{v}, \\ -\beta l(v_t) & \text{if } v_t < \tilde{v}, \end{cases} \tag{4}$$

where β is the coefficient of loss aversion (Tversky and Kahneman 1991). Consistent with loss aversion, we posit that $\beta > 1$; that is, losses loom larger than gains in decision making.[3] Note that if there are no gains or losses (i.e., the actual service path is identical to the "reference" path), our proposed model is simplified to the special case where only the elapsed time matters in the evaluation of the service.

Figure 1 represents consumer decision making using a schematic representation of the model. The first panel shows a reference path (dotted line) and the actual path (solid line), while the second panel shows the corresponding velocity profiles. Gains and losses are represented by the shaded areas and labeled as G and L, respectively. The third panel shows the effect of intertemporal discounting—areas that are further away from the time of decision making are shrunk by a greater degree than areas that are closer. The resulting sum of the shrunken areas ($G_{d1} + G_{d2} - L_{d1} - L_{d2}$) represents the contribution of path characteristics to the final evaluation of the service path (the final evaluation also includes the negative value associated with the elapsed time). Note that this simple schematized version of the model treats time discretely in terms of four segments of the service, while the model in Equation (1) treats time as a continuous variable.

[3] Equation (4) reflects constant loss aversion. Alternately, one could consider a more complicated utility function with diminishing sensitivity, but the extra complexity does not change the nature of the results derived later.

Figure 1 Graphical Illustration of the Model: How Path Characteristics Translate to Velocity and Value



In this paper, we are particularly interested in path characteristics that hinder progress, and we refer to these as obstacles. Two such obstacles are (a) the presence of idle time during the path, and (b) movement away from the final destination (or the presence of *negative displacement*).

(a) *Presence of Idle Time.* A growing body of literature in marketing suggests that consumers are averse to waiting before or during a service (Larson 1987) and that waiting generally reduces service evaluations (Carmon et al. 1995, Taylor 1994). In goal-oriented services, idle time would allow the consumer to focus on the delay, resulting in impatience and frustration. Also, paths with idle times are likely to be seen as inefficient and, hence, of low perceived progress. Consumers will be motivated to minimize potential future frustration and pain (Sawrey and Telford 1971), and hence we expect that they will be more likely to choose services that have no idle time.

(b) *Presence of Negative Displacement.* Feelings of goal impediment and frustration will also occur when the service takes the consumer in a direction opposite to the destination for some portion of the elapsed time. Traveling in the opposite direction is counter to goal-oriented behavior, and hence can be seen as a source of frustration (Locke and Latham 1990, Sawrey and Telford 1971). Hence, we propose that the presence of negative displacement will reduce the choice likelihood.

To model the presence of obstacles, without loss of generality, suppose that a service alternative of elapsed time T consists of an idle period $(t_I, t_I + T_I)$ and a negative displacement of time period $(t_N, t_N + T_N)$.[4] Therefore, an idle of length T_I starts at time t_I and a negative displacement of length T_N begins at time t_N. We let $-v_N$ $(v_N > 0)$ denote the velocity of negative displacement. According to Equations (3) and (4), during the service segment of idle period, a consumer's predicted value $u(v_t = 0) = -\beta\tilde{v}$. Thus, a consumer's total predicted value from the entire idle period $(t_I, t_I + T_I)$ (denoted as U_I) is

$$U_I = \int_{t_I}^{t_I+T_I} (-\beta\tilde{v})\delta^t\, dt = -\beta\tilde{v}\frac{1-\delta^{T_I}}{-\ln\delta}\delta^{t_I}. \qquad (5)$$

It can also be shown that a consumer's total predicted value from the entire period of negative displacement (denoted as U_N) is

$$U_N = \int_{t_N}^{t_N+T_N} (-\beta)(\tilde{v}+v_N)\delta^t\, dt = -\beta(\tilde{v}+v_N)\frac{1-\delta^{T_N}}{-\ln\delta}\delta^{t_N}. \qquad (6)$$

Finally, because a larger magnitude of positive displacement has to occur in a period of time shorter than the elapsed time, the velocity in these segments (assumed constant) is

$$v_p = \frac{D + v_N T_N}{T - T_I - T_N}.$$

[4] Detailed proofs of all results are available from the authors.

As a result, consumers experience gain during the segment of positive displacement for a reasonable value of $\tilde{v}$. We can show that the predicted value from all positive displacement segments is

$$U_p = \int_{[0,T]\backslash[t_I, t_I+T_I]\backslash[t_N, t_N+T_N]} (v_p - \tilde{v})\delta^t\, dt = (v_p - \tilde{v})\frac{(1-\delta^T) - \delta^{t_I}(1-\delta^{T_I}) - \delta^{t_N}(1-\delta^{T_N})}{-\ln\delta}. \qquad (7)$$

The predicted value of the entire service path is a summation of predicted value of all three types of service segments $[U = U_p + U_I + U_N - c(T)]$. Using (5), (6), and (7) and assuming that $\delta = 1$, we can simplify the predicted value of service to $U = -(\beta-1)[\tilde{v}T_I + (\tilde{v}+v_N)T_N] + (D - \tilde{v}T) - c(T)$. Because $\beta > 1$, the presence of such obstacles including both idle and negative displacements would decrease the predicted service valuations for a given T. Service paths with idle and/or negative displacements are anticipated to offer lower valuation than the reference path (constant velocity) of the same elapsed time. This result holds for sufficiently large values of δ (including the values typically found in the literature). Obviously, when δ is very low, the future does not matter much and choice will be heavily influenced by earlier periods.

Location of Obstacles

Previous research shows that consumer decision making is influenced by visceral factors like irritation and frustration when these painful events occur within temporal proximity rather than when they are temporally delayed (Loewenstein 1996), and their behavioral impact is also greater when they are proximal (Soman 1998, 2002). In choosing goal-oriented services, the presence of a temporally proximal obstacle will make the anticipated frustration and pain more salient, and hence may strongly influence choice behavior. However, if the obstacle occurs later, the effect on choice behavior will be weaker (Liberman and Trope 1998, Soman 2002).

In our model, the location of idle is described by t_I. To show how the location of idle affects the predicted service value (U), we derive the marginal effect by taking the first-order derivative, $\partial U/\partial t_I = [v_p + (\beta-1)\tilde{v}](1-\delta^{T_I})\delta^{t_I} \geq 0$. The positive derivative indicates that *the predicted service value (U) will be higher* *with larger t_I (later idle)*. Similarly, we model the location of negative displacement by t_N. Following the same approach for the negative displacement, we compute $\partial U/\partial t_N = [v_p + (\beta - 1)\tilde{v} + \beta v_N](1 - \delta^{T_N})\delta^{t_N} \geq 0$. The positive derivative shows that *predicted service valuation is higher with larger t_N (a later negative displacement)*.

In summary, we predict that:

(a) The presence of idle time and negative displacement would reduce the choice likelihood of a service path, and

(b) Conditional on the presence of idle time or negative displacement, the choice likelihood is lower if these obstacles occur earlier during the elapsed time.

Note that our model considers virtual progress as an aggregate of moment-by-moment values based on suitably discounted perceived progress as anticipated at that moment. In contrast, we conceptualize mathematically computed progress on the basis of the overall path. Therefore, virtual progress could be considered to be an evaluation akin to the aggregation of local evaluations, rather than one global evaluation.

Experimental Evidence

We next report the results of six experiments designed to test the above two predictions and to highlight the importance of virtual progress to consumer decision making. In the first four, subjects compared a pair of service options that were identical in terms of start and destination states. Each subject saw a one-page questionnaire with two options from one of the following domains: (a) transport, (b) medical treatments, and (c) supplier selection decisions. Because the stimulus materials and the experimental procedures are similar across experiments, we describe them in detail here.

Transport (Flight or Train) Choices

Subjects in the transport domain were asked to imagine that they were planning to make reservations for an upcoming trip between a specified pair of cities. They were then asked to choose from a pair of flights or train routes. The routes were either nonstop or involved a stop at a third specified city. All cities in a given experiment were selected such that their spatial arrangement was roughly linear. A map showing the relative positions of the cities was provided as part of the stimulus material. Information about the routes was provided using standard "travel agent" or "timetable" formats, in which the arrival and departure times from a given city as well as the distance traveled in each segment was provided.

In all experiments, subjects faced a choice between a control option (uniform velocity between start and destination state) and a test option that included idle time or negative displacement. All subjects were told that they were not interested in sightseeing and that they could not leave the train or plane when it had stopped (except to make a connection). In some experiments, the control option was priced marginally higher than the test option; therefore subjects had to incur a cost to choose it.

Choosing Medical Treatments

Subjects in this domain made a choice between a pair of treatment plans for high blood glucose. They were told to imagine that after a routine health checkup, their doctor had told them that their blood glucose level was higher (200 mg/dl) than ideal (100 mg/dl). They were further told: "Having a glucose level of 200 isn't a serious problem in the short run (the acceptable range is 75 to 225). There are no negative effects and no immediate reactions. However, having a high glucose level over a period of a few years is harmful. Specifically, it can result in damage to kidneys, vision, and sensations. Your doctor says you should start a treatment course that will reduce the blood glucose to 100 within a 50-day period."

Subjects read that treatments for high blood glucose are based on a combination of injections, medications (tablets), and dietary restrictions, and that the pattern of change of the glucose level over time depends on the order in which these elements are given. Specifically, glucose levels might rise and fall temporarily during the course of the treatment, but would always remain within the acceptable range. Finally, subjects faced a choice between two treatment plans, both of which would reduce the glucose level from 200 to 100 over a 50-day period. Information about the anticipated glucose levels over the 50-day period was presented in the form of a plot over time. In the control plan, the blood glucose level reduces uniformly at the rate of 2 per day over the 50-day period. In the test plan, the change is not uniform and had either an idle or a negative displacement.

Subjects read that from a *medical perspective, both treatments are equally beneficial* and that the doctor "encourages you to choose the treatment that you think you are *more comfortable* with." Both treatments involved the same number and schedule of visits to the doctor's office, but the control option was described as "a more rigid program requiring extra effort on your part to carefully monitor and self-administer medications and perform glucose testing using a home kit." Subjects who chose the control option thus incurred an additional cost of monitoring and testing.

Building Machines

Subjects in this domain were asked to imagine that the factory they were working for was in the process of selecting a supplier who would build and install 80 new machine tools. The work would be carried out over 20 weeks, and would be done in the evening with the new machines occupying designated new areas that would cause no disruption to regular production. Subjects were also told that the new machines could not be used until all 80 had been installed because they would all be linked to a common computer.

Subjects then faced a choice between two suppliers. One supplier (the control option) would build and install at the uniform rate of four machines per week and would guarantee completion in 20 weeks. Due to prior commitments, the second supplier (test option) would do the installation with a four-week recess in the middle. This supplier would contract to work at the rate of five machines per week, and therefore would also guarantee completion in a total of 20 weeks. Both suppliers quoted the same total price; however, the test supplier offered an extended warranty on the machines (11 years instead of 10). Subjects who chose the control option therefore incurred the opportunity cost of foregoing the extended warranty offer on their machines.

Note that in the medical treatment and building machines domains, the control options as described earlier were identical across all experiments and will not be described separately in the rest of the discussion.

Dependent Variables and Other Measures

The dependent variable in all experiments was the choice that the subject made between the control and test options. In some cases, the choice measure was augmented or replaced by a relative preference measure on a 9-point scale, with 5 indicating indifference. These choice measures were always collected before any other measures were taken. For the purposes of discussion, we have scaled the choice and relative preference measures such that *higher* numbers indicate a greater preference for the *test* option involving idle time or negative displacement.

In some cases, we also measured the perceived progress (PROG) and the extent to which subjects were confident that the service would proceed as scheduled (PATH). To measure PROG, we used two items on which subjects indicated their agreement on 9-point scales (1 = Completely Disagree, 9 = Completely Agree). The first item was "This path used the [elapsed time period] effectively in reaching the destination;" while the second item was "I will experience a sense of progress or accomplishment as I go through the [elapsed time period]." The correlation between the two items was consistently high (ranging from 0.78 to 0.93 across experiments); hence, we used the average of these two items as a measure of perceived progress (PROG). Subjects were also asked to indicate PATH on a 9-point scale, "based on the information provided, please indicate whether you believe that the [service] will *not* progress as per the described [path]." This measure was collected to rule out the possibility that our results were driven by the inference that the service was more likely to proceed per schedule in the control condition than in the test condition. Both PATH and PROG measures were taken after the choice measure. In experiments using student subjects, we collected these measures in a separate questionnaire after unrelated tasks to minimize the possibility of halo effects causing self-generated validity (Feldman and Lynch 1988).

We next discuss each experiment by referring to an accompanying table that lists details (like subject populations and sample sizes) as well as the results and analysis.

Experiment 1

The objective of this experiment was to test for the effect of the presence of idle on choice. In three domains, subjects chose between two paths, a uniform velocity path that occupied the total elapsed time (control) or a path that included a period of idle. In the transport domain, subjects chose from two train routes between Boston and New York. Both trains left Boston at 5:00 pm, arrived in New York at 10:00 pm, and charged the same fare. The control option ostensibly traveled nonstop at a uniform velocity between these stations, while the test option traveled faster, but had a 30-minute stop at Hartford, approximately midway between the start and destination cities. In the medical treatment domain, the test option reduced at a uniform rate of 2.5 per day for the first 20 days, then stayed constant for a 10-day period, and again reduced at 2.5 per day for the next 20 days. Also, in the machines domain, the test option installed new machines at the rate of five machines per week for the first eight weeks, followed by an idle period of four weeks, and a final period of eight weeks at the rate of five machines per week. Table 1 provides experimental details and results.

Results and Discussion

In the transport domain, the two options were matched in terms of price, as well as start and destination states. As such, subjects should have been indifferent to the two routes, and in the medical treatment and building machines domains, subjects actually had to incur a cost to choose the control option. With the start and destination states being matched, choices should have been driven towards the test option because of the lower monitoring cost and the increased warranty, respectively. As Table 1 shows, however, the proportion of subjects choosing the test option in all three domains was significantly lower than indifference. The relative preference scores were also indicative of a significant preference for the control option. Mean PATH scores were not different for the control and test options ($X_{control} = 2.91$, $X_{test} = 3.09$, $p > 0.75$ for medical treatment; $X_{control} = 3.11$, $X_{test} = 3.19$, $p > 0.80$ for building machines), suggesting that subjects did not make any inferences that the control path was more "valid" than the test path. Across the three domains, this pattern of choices could then be explained by the greater perceived progress of the control option.

We measured perceived progress in both the medical treatment and building machines domains (in the latter domain, PATH and PROG were measured in a separate questionnaire after a significant time gap). In both cases, the PROG scores were significantly greater in the control condition than in the test condition ($PROG_{control} = 6.01$, $PROG_{test} = 5.07$, $p < 0.001$ for medical treatments; $PROG_{control} = 6.74$, $PROG_{test} = 4.60$, $p < 0.001$ for building machines). Apparently, the greater perceived progress of the control option drove choices towards it.

Table 1 Summary and Results: Experiment 1

Domain	Subjects	Number of subjects (n)	Number choosing alternative with idle (%)	Number choosing control (%)	χ^2 Statistic (comparison with indifference)	p-value	PREF score	p-value
Transport	University of Colorado undergraduates	80	23 (28.75)	57 (71.25)	14.45	<0.001	—	—
Medical treatment	Patients at a doctor's office	74	25 (37.84)	49 (62.16)	7.78	<0.01	3.84	<0.01
Building machines	MBA students	84	22 (26.19)	62 (73.81)	19.05	<0.001	3.74	<0.01

Note. Subjects in Domains B and C indicated a choice and also indicated a relative preference, PREF, measured on a 9-point scale (1 = definitely choose control, 5 = indifferent, 9 = definitely choose alternative with idle). p-values for PREF and choice are for a test of comparison with indifference.

Experiment 2

The objective of this experiment was to test for the prediction than a service with a later idle is relatively more attractive and has a higher likelihood of choice than a service with an earlier idle. In all three domains, subjects were randomly assigned to one of three idle conditions, an "*early*," "*medium*," or "*late*" idle.

In the transport domain, subjects faced a choice between two itineraries connecting Seville (Spain) with Oslo (Norway). The control option was a four-hour nonstop flight between these two cities, and the test option had an elapsed time of five hours, including a one-hour long stop at an intermediate city. The price of the control option was $300, while that of the one-stop test option was $260 in all conditions. All flights had an identical arrival time of 5:00 pm in Oslo. In the early idle condition, the idle was at Madrid, a 45-minute flight from Seville. In the medium idle condition, the idle was at Paris, a 2-hour flight from Seville. In the late idle condition, the idle was at Copenhagen, a 3-hour and 15-minute flight from Seville.

In the medical treatment domain, the test option reduced the glucose level at a uniform rate of 2.5 per day in the first period of time (the first 10 days for early idle, 20 days for medium idle, and 30 days for late idle), then stayed constant for a further 10 days and again reduced at 2.5 per day for the remaining (30, 20, and 10, respectively) days. In the machines domain, the test option installed new machines at the rate of five machines per week for the first period (of four weeks for early idle, eight weeks for medium idle, and twelve weeks for late idle), followed by an idle period of four weeks and a final period (of twelve, eight, and four weeks, respectively) at the rate of five machines per week. Table 2 shows details about the subject population and sample sizes, as well as the results and analysis.

Results and Discussion

For all three domains, subjects across the three conditions faced a choice between a pair of options that were otherwise identical, but differed only in the location of the idle period in the test option. We find a significant main effect of idle position, such that the test option became relatively more attractive as the idle occurred later on during the elapsed time. Specifically, the preference for the test option was the lowest in the early idle condition, significantly greater in the medium idle condition, and the highest in the late idle condition.

We also measured PATH scores for both the control and test options across the three experimental conditions in the medical treatment domain and ran an ANOVA with idle position as a between-subjects

Table 2 Summary and Results: Experiment 2

Domain	Subjects	Dependent variable	Idle condition	N	Mean PREF for idle option	Test statistic (pairwise comparisons)	p-value
Transport	University of Colorado Students	Choice	Early	34	26.47%	$\chi^2(1) = 3.61$ (Early vs. Medium)	<0.05
			Medium	37	48.65%		
			Late	32	68.75%	$\chi^2(1) = 2.80$ (Medium vs. Late)	<0.09
Medical treatment	Hong Kong UST students	Relative preference (9-point scale)	Early	20	3.2	$t_{41} = 2.15$ (Early vs. Medium)	<0.05
			Medium	23	4.35		
			Late	24	5.63	$t_{45} = 2.05$ (Medium vs. Late)	<0.05
Building machines	Visitors to a large airport	Choice	Early	50	8.00%	$\chi^2(1) = 6.05$ (Early vs. Medium)	<0.02
			Medium	50	28.00%		
			Late	50	66.00%	$\chi^2(1) = 13.73$ (Medium vs. Late)	<0.0001

Note. Higher PREF indicates a greater preference for the alternative containing the idle as compared to the control (uniform velocity, no-idle alternative).

independent variable and option (control vs. test) as a within-subjects independent variable. ANOVA results yielded no significant effects (all p's > 0.45), suggesting that different confidence levels about the schedules did not drive our results.

We also measured the perceived progress (PROG) in a separate questionnaire for the medical treatment domain. The mean PROG score for the control option did not differ across the three experimental conditions ($PROG_{control} = 6.16$). However, consistent with our expectation, the mean PROG score for the test option was the lowest in the early idle condition ($PROG_{early} = 2.95$), significantly greater in the medium idle condition ($PROG_{medium} = 4.04$, $p < 0.01$), and the highest in the late idle condition ($PROG_{late} = 5.71$, $p < 0.01$). The increase in choice for the test option as the idle period happened later in the elapsed time seemed to be driven by a simultaneously increasing perception of progress of the test path.

Experiment 3

The objective of Experiment 3 was to demonstrate that the presence of a negative displacement in a path would lower its attractiveness. In the transport domain, subjects were asked to imagine that they were in a foreign country that had high-speed trains on certain routes, and that they needed to travel 300 miles from Border to Hughes. They had a choice between two options with identical departure time from Border (10:00 am) and arrival time at Hughes (2:15 pm). All routes involved an idle time in the form of a 15-minute train stop at a station 75 miles and 45 minutes from the start state, and an identical fare of 50 Pascoes in the local currency. In the control option seen by all subjects, the train stop was at a town called Warne, which was between Border and Hughes. The test option was a second train that initially traveled and stopped at Lillee, which was on the line joining Border and Hughes, but on the other side of Border as Hughes (see Figure 2). After this stop, the train proceeded nonstop to Hughes as an express train. In the medical treatment domain, the test option initially increased the glucose level at the rate of three units per day for the first eight days. At this time, the blood glucose level was 224 (which was still in the acceptable range). For the remaining 42 days, the glucose level declined uniformly at the rate of 2.95 per day, and finally stabilized at 100 at the end of the 50-day period.

Results and Discussion

In the transport domain, the control and test options were matched in terms of start and destination states,

Figure 2 Relative Location of Cities in Transport Domain: Experiment 3

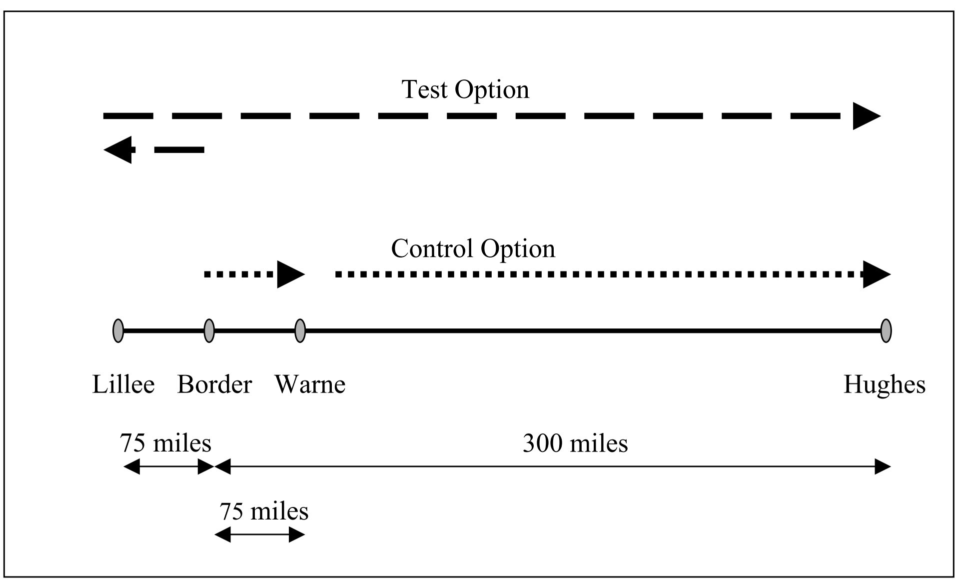


Table 3 Summary and Results: Experiment 3

Domain	Subjects	Number of subjects (n)	Choice for alternative with negative displacement (%)	χ^2 Statistic (comparison with indifference)	p-value	Relative PREF score	p-value
Transport	Passengers at a train station	100	25 (25.00)	25.00	<0.01	3.84	<0.01
Medical treatment	Visitors to a pharmacy store	90	21 (23.33)	21.51	<0.01	3.49	<0.01

Note. PREF was measured on a 9-point scale (1 = definitely choose control, 5 = indifferent, 9 = definitely choose alternative with negative displacement). p-values for PREF are for a test of comparison with Indifference.

as well as price. As such, subjects should have been indifferent between the two. In the medical treatment domain, subjects' choices should have been driven away from the control option due to the larger monitoring costs associated with it. However, Table 3 shows that in both domains, subjects displayed a strong and significant preference for the control option for both actual choice and relative preference measures. This pattern of choices is consistent with the greater anticipated perceived progress made in the control option. Specifically, in the transport domain the mean PROG score for the control option ($PROG_{control} = 6.12$) was significantly greater than the mean PROG score in the test option ($PROG_{test} = 3.93$, $p < 0.001$).

We also interviewed a subsample ($n = 20$) after they had turned in their surveys and asked them to provide reasons for their choice. A total of 38 choices (average 1.9, range 1–3 per respondent) were coded by three independent coders as relating to either (a) uncertainties associated with the paths (e.g., "trains often break down and if this happens, I'd rather be closer to my destination than further"), (b) progress-related reasons (e.g., "It seems to be a waste to go in the opposite direction," or "I seem to be getting to where I want to go smoothly and without unnecessary excursions"), or (c) personal preferences and miscellaneous reasons (e.g., "I prefer riding on express trains"). The coders agreed on 34 items, and the remaining 4 were categorized by discussion. Uncertainties accounted for 21% (8/38), personal preferences for 32% (12/38), while progress-related reasons accounted for 47% (18/38) of the provided reasons. While other factors might have had a role to play in decision making, the anticipated perceived progress made in the control condition seemed to be driving choices towards it.

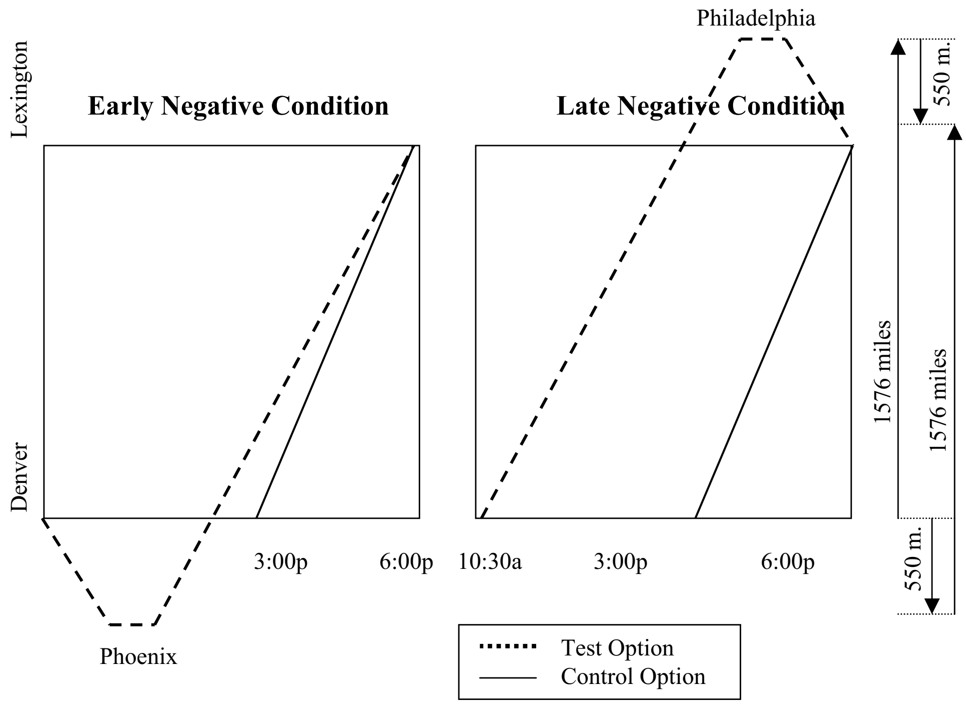
Experiment 4

In this experiment, subjects chose between two options, one of which included some negative displacement. The negative displacement was located either at the beginning or at the end of the elapsed time. We predict that the choice likelihood would be greater if the negative displacement occurs at the end.

In the transport domain, subjects were asked to imagine that they were making a reservation for (an eastward) airline travel between Denver, CO and Lexington, KY. The control option was a nonstop flight departing Denver at 3:00 pm, arriving in Lexington at 8:00 pm local time and costing $355. In both conditions (each costing $238), the test option left Denver at 10:30 am, had a 20-minute layover, and arrived in Lexington at 8:00 pm local time (6:00 pm Denver time). In the early negative condition, the connection was at Phoenix, AZ, resulting in a negative (westward) displacement for the first segment of the journey. In the late negative condition, the connection was at Philadelphia, PA, resulting in a westward displacement in the last segment of the flight. These cities were selected so that the westward displacement in both cases was approximately 550 miles, the eastward displacement was approximately 1,575 miles, and the total flight distance in both cases was exactly 2,126 miles (Figure 3).

In the medical treatment condition, the test option in the early negative condition was identical to the one

Figure 3 Displacement—Time Plots for Transport Stimuli: Experiment 4



used in Experiment 3. In the late negative condition, the treatment reduced the glucose level for the first 42 days at a uniform rate of 2.95 per day. At the end of this period, the glucose level was 76 (still in the acceptable range). For the last eight days, the glucose increased at a uniform rate of 3 per day and stabilized at the level of 100 at the end of the 50-day period.

Results and Discussion

The choice task for subjects in the early and late negative conditions was identical except for the location of the negative displacement in the test option. We predicted that the preference for the test option would increase as the negative displacement occurred later on during the elapsed duration. As Table 4 shows, the

Table 4 Summary and Results: Experiment 4

Domain	Subjects	Dependent variable	Negative displacement condition	*N*	Mean PREF for negative displacement option	Test statistic (pairwise comparisons)	*p*-value
Transport	Passengers waiting for flights at a large international airport	Choice	Early	30	33.33%	$\chi^2(1) = 6.67$	<0.01
			Late	30	66.66%		
		Relative preference (9-point scale)	Early	30	3.60	$t_{58} = 2.07$	<0.05
			Late	30	4.90		
Medical treatment	University of Colorado students	Relative preference (9-point scale)	Early	28	3.25	$t_{53} = 2.02$	<0.05
			Late	27	4.33		

Note. PREF was measured on a 7-point scale (1 = definitely choose control, 4 = indifferent, 7 = definitely choose alternative with negative displacement) in the transportation domain and a 9-point scale in the medical treatment domain.

results of the experiment for both the transport and medical treatment domains are consistent with this expectation.

As in previous experiments, we asked subjects in the medical treatment domain for their PATH and PROG scores in a separate questionnaire. When analyzed in an ANOVA with the negative position as a between-subjects factor and control vs. test option as a within-subject factor, the PATH yielded no significant effects (all p's > 0.60), implying that our results could not be explained by differences in beliefs about the validity of the paths. The mean PROG scores, however, are consistent with our theorizing. Specifically, the mean PROG score for the control option was no different across the two experimental conditions ($PROG_{control} = 6.23$). However, the mean PROG score increased significantly from the early negative condition ($PROG_{early} = 2.57$) to the late negative condition ($PROG_{late} = 5.63$, $p < 0.01$).

Experiments 1–4 collectively supported our predictions. However, these results still begged two questions. First, we did not know whether the effects of idle and negative displacement and their location interacted with each other. We had no reason to expect any interactions, but wanted a within-subjects replication in which each subject was exposed to numerous test options in which idle and negative displacement coexisted. We note that there are both pros and cons to using within-subjects designs rather than between-subjects designs. As one speculation, within-subject designs may make the subject cognizant that the progress computed over the entire path was in fact constant for all options and may, hence, weaken the effects of virtual progress. On the other hand, the within-subject design may also artificially highlight the differences in paths across the conditions and strengthen the effects of virtual progress. Given that no one option was obviously superior, we felt that it was important to use both. Second, we wanted to address the managerially relevant question of whether these differences in predicted utility translate to differences in willingness to pay for the service. Both of these questions are addressed next.

Experiment 5

Subjects and Procedure

Eighteen students from a state university participated in this experiment (part of several unrelated studies) in exchange for course credit. Subjects received an experimental booklet entitled *Traveling in Longland* and were asked to imagine that they were exchange students in a (fictitious) country called Longland. The geography and train network of this country were described (see Figure 4). Subjects were told that "you need to go from A to B to get some paperwork done regarding your trip back to the USA. The quickest way to do this is to catch a high-speed nonstop train from A to B (called the "AB Express") which leaves A at 10:00 am and arrives in B at 5:00 pm. However, the fare for this train is 300 Dnoups" (the Dnoup is the local currency, 1 Dnoup = 1 U.S. dollar). They were further told that there were a number of cheaper options available, all of which left A at 10:00 am and arrived in B at 8:00 pm. They were told that "on each of the following nine pages, you will be shown the itinerary of one option. For each option, please indicate the price (in Dnoups) you would be willing to pay; i.e., a price that you think is a fair price for the itinerary. Remember that once you board the train at A, you cannot leave it until you reach B." They were also reminded that "trains travel at roughly a constant speed between two stations," but that the same train could be a regular speed train for one segment and an express for another segment of the journey. Subjects were also instructed to "look carefully at all the available options before writing down your responses."

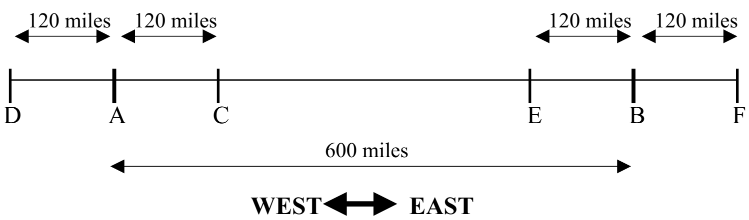
Design

The nine options were created by fully crossing three levels of the idle factor with three levels of the negative displacement factor. For the idle factor, there was either no idle, an early idle between 11:00 am and 12:00 pm, or a late idle between 6:00 pm and 7:00 pm. For negative displacement, there was either no negative travel, negative travel of 120 miles at the start (10:00 am to 11:00 am, from A to D), or negative travel of 120 miles at the end (7:00 pm to 8:00 pm, from F to B). This experiment employed a 3 (idle: no, early, late) $\times$ 3 (negative displacement: no, early, late)

Figure 4 Description of the Transport Domain in Longland: Experiment 5

Geography:

Longland is a fairly narrow and long country. It stretches from East to West for about 900 miles, but it is only about 50–100 miles along the North-South direction. There are two large metropolitan cities, *Arundham* (where your University is) and *Bordham*. There are four other major cities, *Chatham*, *Durham*, *Evatham* and *Frotham*. In this booklet, we will refer to these cities by the first letter of their name (i.e., A, B, C, D, E, and F). The following map shows the relative locations of and distances between these cities.



Transportation:

The six major cities are connected by a train system. Trains operate to and from between D and F either as *regular speed* (about 40–70 m.p.h.) trains or *high* speed trains (about 90–120 m.p.h.). The same train sometimes operates at different speeds during different segments of the journey. Also, due to logistical reasons, trains do not stop at all stations. For instance, sometimes you could have a train that starts from D, travels eastward as a regular-speed train to A, then travels as a high-speed train to F, and on its return journey stops at B and E. If you were a passenger on this train and wanted to go from A to B, you could get on the train, travel to F, stay on the same train on its return journey, and get off at B. While such train journeys might seem cumbersome, you do not have to leave the train once you have boarded.

full-factorial within-subjects design. Table 5 shows the details of each experimental condition.

After completing the questionnaire, subjects spend approximately 30 minutes performing other, unrelated tasks. They were then given another booklet entitled *Train Journeys* in which they again saw the nine options and were asked to rate each on perceived progress (PROG).

Table 5 Description of Stimulus: Experiment 5

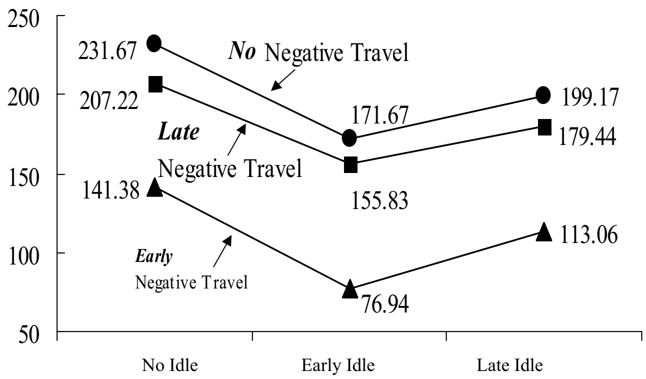
Condition	Idle	Negative displacement	Location of idle	Location of negative
1	No	No	—	—
2	Early	No	C	—
3	Late	No	E	—
4	No	Early	—	A to D
5	Early	Early	D	A to D
6	Late	Early	E	A to D
7	No	Late	—	F to B
8	Early	Late	C	F to B
9	Late	Late	F	F to B

Note. The duration of idle and negative displacement was one hour in all conditions. The locations are in reference to the map in Figure 4.

Results and Analysis

In assessing the willingness to pay (WTP) for each route, subjects had to trade-off money (300 Dnoups for control) against the additional time it would take to complete the journey (8 hours for control

Figure 5 **Mean Willingness to Pay (WTP) as a Function of Idle and Negative Displacement: Experiment 5**



vs. 10 hours for test option). Because this trade-off was identical for all nine options, any differences in WTP could be attributed to differences in virtual progress.

A 3 (idle) × 3 (negative displacement) ANOVA with WTP as the dependent variable revealed significant main effects of idle ($F_{2,153} = 47.95$, $p < 0.001$) and negative displacement ($F_{2,153} = 125.79$, $p < 0.001$), while their interaction did not approach significance ($p > 0.85$). Mean WTP scores are plotted in Figure 5 and are consistent with our predictions. Specifically, we find that WTP is highest when there is no idle ($X = 193.43$), but significantly lower when there is a late idle ($X = 163.89$, $F_{1,159} = 9.54$, $p < 0.005$), and even lower when there is early idle ($X = 134.81$, $F_{1,159} = 37.58$, $p < 0.001$). Similarly, WTP is highest when there is no negative travel ($X = 200.83$), significantly lower with a late negative travel ($X = 180.83$, $F_{1,159} = 7.10$, $p < 0.01$), and even lower when there is early negative travel ($X = 110.46$, $F_{1,159} = 144.97$, $p < 0.001$). Collectively, these results support our predictions.

In a separate set of analysis, we used individual-level WTP and PROG data in regression models to test for the mediating effect of perceived progress on the evaluation (WTP) of each option. Using dummy variables to represent the three levels of idle and negative displacement, we ran the following regression models to establish mediation (Baron and Kenny 1986):

$$\text{Model 1:}\quad \text{WTP} = \alpha + \beta 1\ (\text{idle}) + \beta 2\ (\text{negative displacement}),$$

$$\text{Model 2:}\quad \text{PROG} = \alpha + \beta 1\ (\text{idle}) + \beta 2\ (\text{negative displacement}),$$

$$\text{Model 3:}\quad \text{WTP} = \alpha + \beta 1\ (\text{idle}) + \beta 2\ (\text{negative displacement}) + \beta 2\ (\text{PROG}).$$

In Model 1, coefficients for both idle ($\beta 1 = -14.77$, $p < 0.005$) and negative displacement ($\beta 2 = -10.00$, $p < 0.05$) were significant. Similarly, in Model 2, both idle ($\beta 1 = -0.50$, $p < 0.01$) and negative displacement ($\beta 2 = -0.42$, $p < 0.05$) were significant. However, when PROG was added as a covariate (Model 3), PROG was significant ($\beta 3 = 24.15$, $p < 0.001$), while the coefficients of the previously significant idle ($\beta 1 = -2.69$, $p = 0.26$) and negative displacement ($\beta 2 = -0.06$, $p < 0.96$) both reduced in value and were not significant. These results strongly suggested that perceived progress mediated the relationship between path characteristics and likelihood of choice.

Model Estimation

Because we had individual-level data for WTP, we were able to fit the proposed model to these data. We first estimate the following conjoint model.

$$\text{WTP} = \gamma_0 + \gamma_1 \times \text{early\_idle} + \gamma_2 \times \text{late\_idle} + \gamma_3 \times \text{early\_ND} + \gamma_4 \times \text{late\_ND} + \varepsilon, \tag{7}$$

where γ_0 is WTP for the service under Condition 1 (see Table 5), and variables early_idle, late_idle, early_ND, and late_ND are dummy variables indicating the presence of the respective obstacle. The model fits well ($R^2 = 88.4\%$), and the estimation results are shown in the first panel of Table 6.

Next, we turn to our proposed theoretical model. This can be represented as

$$\text{WTP} = \alpha + U_I + U_N + U_p - c(T) + \varepsilon, \tag{8}$$

where U_I, U_N, and U_p are given by Equations (5), (6), and (7), respectively. In the experiment ($t_I = 1$, $T_I = 1$)

Table 6 Model Estimation Results: Experiment 5

			Estimates		Standard error			t-value	
Conjoint model ($R^2 = 88.40\%$)									
γ_0 (constant)			229.815		2.913			78.902	
γ_1 (early_idle)			−58.611		3.191			−18.369	
γ_2 (late_idle)			−28.333		3.191			−8.88	
γ_3 (early_ND)			−89.167		3.191			−27.946	
γ_4 (late_ND)			−20		3.191			−6.268	
Proposed model ($R^2 = 87.8\%$)									
δ	0.81	0.82	0.83	0.84	0.85	0.86	**0.87**	0.88	0.89
R^2	0.861	0.865	0.869	0.873	0.876	0.877	**0.878**	0.876	0.872
δ	0.9	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98
R^2	0.864	0.852	0.835	0.812	0.783	0.746	0.715	0.651	0.594
Proposed model ($\delta = 0.87$)									
λ_0 (constant)			229.73		2.41			95.44	
λ_1 (idle)			−70.93		3.97			−17.87	
λ_2 (ND)			−97.1		3.39			−28.67	

for an early idle, ($t_I = 8$, $T_I = 1$) for a later idle, ($t_N = 0$, $T_N = 1$, $v_N = 120$) for an early negative displacement, and ($t_N = 9$, $T_N = 1$, $v_N = 120$) for a late negative displacement. Substituting the above information and ($T = 10$, $D = 600$) into Equations (5) to (8), we can rewrite Equation (8) into the following format:

$$\text{WTP} = \lambda_0 + \lambda_1 \times A + \lambda_2 \times B + \varepsilon \tag{9}$$

where

$$A = \frac{1-\delta}{-\ln\delta}(\text{early\_idle} \times \delta + \text{late\_idle} \times \delta^8), \tag{10}$$

$$B = \frac{1-\delta}{-\ln\delta}(\text{early\_ND} + \text{late\_ND} \times \delta^9), \tag{11}$$

$$\lambda_1 = -(\beta - 1)\tilde{v}, \tag{12}$$

$$\lambda_2 = -[(\beta-1)\tilde{v} + \beta \times (120\rho)], \tag{13}$$

$$\begin{aligned}\lambda_0 &= \alpha - \tilde{v}\frac{1-\delta^{10}}{-\ln\delta} + v_p\left(\frac{1-\delta^{10}}{-\ln\delta} - A - B\right) - c(T) \\ &\approx \alpha + (D - T\tilde{v}) - c(T) \\ &= \alpha + (600 - 10\tilde{v}) - c(10). \end{aligned} \tag{14}$$

Equation (9) suggests that the main effect of a one hour-long idle is measured by $\lambda_1 \times A$, where ($\text{early\_idle} \times \delta + \text{late\_idle} \times \delta^8$) models the effect of timing. Similarly, the main effect of a one hour-long negative displacement is measured by $\lambda_1 \times B$, where ($\text{early\_ND} + \text{late\_ND} \times \delta^9$) models the effect of timing. In Equation (13), we add a parameter ρ to model the potential concavity of loss function where $\rho \in [0, 1]$. As long as the discount factor δ is sufficiently close to 1, all of our proofs for the effects of idles and negative displacements remain valid for any $\rho > 0$.

There are five parameters in this family of equations, $(\alpha, \beta, \delta, \tilde{v}, \rho\}$. However, with the available data, we can only identify four parameters, $\{\lambda_0, \lambda_1, \lambda_2, \delta\}$. We interpret λ_1 and λ_2 as the effect of idles and negative displacements, respectively. Equation (9) is nonlinear with respect to the parameter δ. As a consequence, the search for the globally optimal estimates turned out to be very unreliable. Because the equation was nonlinear only with respect to δ, we first estimate (9) as a linear model with each feasible value of δ and then choose the set of estimates with the highest value of R^2. The second panel of Table 6 shows the values of R^2 for the model (9) estimated from the pooled data of all 18 subjects. We present the results for a range of δ from 0.81 to 0.98, and we chose 0.87 as the estimate for δ for the maximal value of R^2. The corresponding estimates for other parameters are shown in the third panel of Table 6. The explanatory power of this four-parameter model ($R^2 = 87.8\%$) is as good as the five-parameter Conjoint model ($R^2 = 88.4\%$). We also fitted individual-level models to each of the 18 subjects and found that the proposed model fits as well as the Conjoint model based on the R^2 value criterion. For all individuals, the estimate for discount parameter ranges from 0.8 to 0.91 and the effect of negative displacement is consistently stronger than the effect of idle for all individuals.[5]

Given its theoretical (and therefore nonlinear) nature, and given that the experiment was conducted using a fully crossed design, we did not expect our proposed model to outperform the linear conjoint model. Our goal in estimating the model using the experimental data was simply to ascertain that the parameters were consistent with our expectations and that the model performed reasonably well in terms of fit. As the results show, both of these goals were attained.

Are the Effects of Virtual Progress Real?

Collectively, the first five experiments showed that in situations where the elapsed time (and hence actual progress) is held constant, path characteristics systematically influence consumer choice and their willingness to pay for a service. Further, our proposed model fit the experimental data well. While the results consistently point to the need to pay attention to path characteristics, one criticism of these experiments is the possibility that by holding elapsed time constant, we artificially increased the salience of path characteristics. This criticism was somewhat valid in some of the experiments, but in other cases (Experiments 2, 4, and 5) subjects chose between a control option and a test option that differed both in elapsed time and path characteristics. However, we wanted to establish that path characteristics are more than a marginal factor that operates only when elapsed time is held constant. Experiment 6 was designed with this objective.

Experiment 6

Design and Procedure

We used a 2 (elapsed time) × 2 (virtual progress) between-subjects design. Nonstudent subjects (adults recruited at a popular museum in Chicago) were paid $1 to participate. Stimuli were based on the *Traveling in Longland* setup used in Experiment 6, except that subjects chose between two routes connecting cities 600 miles apart. The control option was identical for all subjects (with a uniform velocity over an elapsed time of seven hours) and the test option differed along the above manipulations. All control and test journeys involved brief stops at two stations. The *elapsed time* of the test option was either 10 hours (short) or 11 hours (long); the virtual progress was manipulated to be either *high* or *low*. In the *high virtual progress* condition, the path was a uniform velocity between start and destination interrupted only with brief stops at two stations. In the *low virtual progress* condition, the journey started off with a negative displacement towards the first stop and was followed by an idle period after which the journey moved at a uniform velocity (interrupted by one brief stop) towards the destination. The four test paths and the control path are shown in Figure 6.

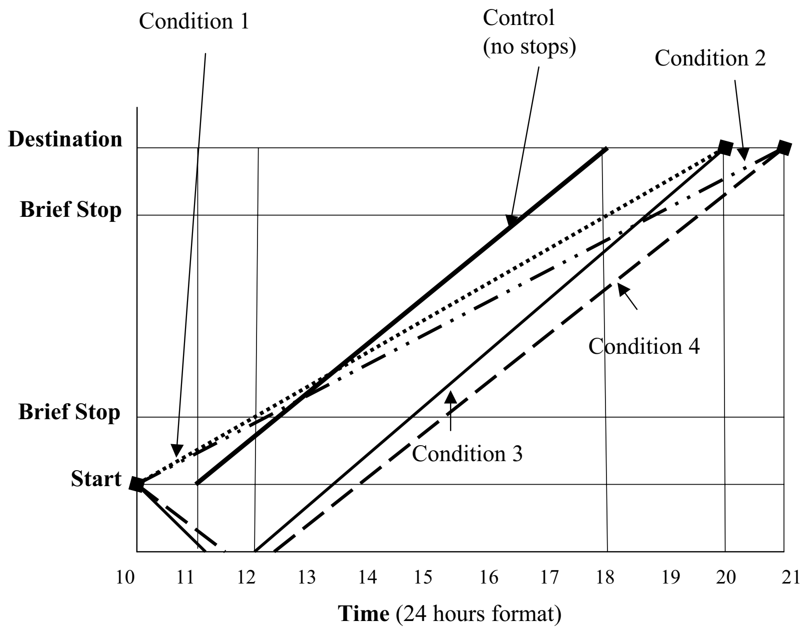
After reading the scenario, we asked subjects to indicate their relative preference (PREF) between control option (priced at $400) and test option (priced at $250 in all conditions). Higher PREF scores represent greater preference—and, hence, higher evaluation—for the test option.

Results

The mean PREF scores for each experimental condition are shown in Table 7. A 2 × 2 ANOVA showed significant main effects of both factors—elapsed time ($F_{1,116} = 5.58$, $p < 0.02$) and virtual progress ($F_{1,116} = 27.77$, $p < 0.001$). As Table 7 shows, virtual progress has a higher level of significance than elapsed time, and a larger effect. Further, we were specifically interested in a preplanned contrast between the two Conditions 2 and 3 (marked in bold) in Table 7. The contrast shows that the evaluation of the long elapsed time-high virtual progress condition is significantly greater than that of the short elapsed time-low virtual progress path ($F_{1,116} = 4.23$, $p < 0.05$). This implies that subjects preferred the path with the longer elapsed time, but with better virtual progress.

[5] Detailed estimation results can be obtained from the authors.

Figure 6 Graphical Representation of the Control and Test Paths: Experiment 6



Conclusion

These results show that consumers are willing to sacrifice time and choose a higher elapsed-time path if it has a higher degree of virtual progress. Apparently, path characteristics do not play a role only when the elapsed time is held constant, but their effects are real.

General Discussion and Conclusions

Summary of Research

This paper studies consumer choice between services that transport them from a start state to a destination state over a period of time. We propose and show that in addition to total cost (i.e., monetary and opportunity cost of time) considerations, certain path characteristics also influence choice behavior by conveying a perception of progress during the elapsed time. We offer an analytical model of consumer choice and experimentally show that the presence of idle time in the elapsed path and the presence of a segment where negative displacement occurs reduce the choice likelihood. Further, this effect is weakened when the idle or negative displacement occurs late in the elapsed time period.

Our empirical work showed that the effects of virtual progress were rather robust. We consistently found support for our predictions across three different domains, with between-subjects as well as within-subjects designs, with binary choice measures as well as relative preference measures (that did not force subjects to make a choice), with graphical as well as tabular representation of information, and using both student subjects and "real consumers" in settings that were realistic and relevant to the choice task. Further, by collecting data from a number of contexts and by measuring the confidence in the service path as well as perceptions of progress towards destination (i.e., PATH and PROG measures), we were able to eliminate a number of alternative explanations and make a case for their robustness. The robustness of

Table 7 Mean Preference Scores: Experiment 6

	Short elapsed time	Long elapsed time
High progress	Condition 1 PREF = 6.60	**Condition 2** **PREF = 5.63**
Low progress	**Condition 3** **PREF = 4.57**	Condition 4 PREF = 3.80

the phenomenon is a testimony to its theoretical and practical importance.

We would like to dwell on our PROG measure and explore what the measure captured. It was our intention that the two dimensions used to estimate PROG would capture two dimensions of perceived progress for the path (i.e., the utilization of the elapsed time, and an overall gestalt measure of progress). Given methodological constraints, however, it is possible that PROG was representing some kind of an overall attractiveness measure. While we minimized the possibility that PROG was simply correlated to choice due to "self generated validity," we would have liked, ideally, to develop and validate a scale for measuring perceived progress. Unfortunately, this was beyond the scope of our present research.

Theoretical and Managerial Implications

Research in the area of organizational behavior and social psychology has studied the importance of goals in achieving success and in subjective well-being (cf. Brunstein 1993, Sheldon and Kasser 1995). However, surprisingly little research (and, to our knowledge, none in marketing) has been done on people's predictions about their experiences as they work to achieve a goal. To our knowledge, the present research is the first to identify perceived progress as a predictor of utility and choice.

Our results in the domain of goal-oriented services may have implications for the well-being of individuals who are working to achieve a goal. We predict that people will like to receive feedback from the environment telling them that they are making progress towards their goal. In the absence of knowing about their progress, people might experience frustration and, hence, be poorly motivated to work further towards their goal.

Note that our research draws a distinction between a mathematically computed progress for the entire path and virtual progress—an aggregate of moment-by-moment values based on perceived progress at that moment. At a conceptual level, this distinction between a global evaluation and an aggregate of several local evaluations is similar in spirit to other consumer behavior phenomena. One striking similarity is with the research on mental accounting (Thaler 1999), which shows that by artificially partitioning their incomes into separate accounts, consumers attend to "virtual" considerations (like budgeting) resulting in a suboptimal allocation of incomes. These parallels suggest a more pervasive tendency to attend to local optimization at the expense of a globally satisfying solution, perhaps because the local optimum is psychologically more satisfying.

While these results are interesting from a purely theoretical standpoint, they have important managerial implications for the design and marketing of services. Results from the experiments suggest that it is important for service providers to ensure that consumers feel that they are moving towards their final destination. Specifically, service providers should attempt to start services as soon as possible, avoid negative displacement, minimize idle times, and attempt to "fill" the idle times with perceptions of progress. It is also important to create perceptions of progress in other settings, i.e., for consumers waiting in queues. Our results suggest that a queue discipline in which consumers can actively see the rate of progress (e.g., a queue which physically moves as consumers are serviced) will result in better service evaluations as compared to another in which the rate of progress is not transparent.[6] In short, while the price and elapsed time of a service influence choice behavior, it is important to create a perception of "being on the move" to increase consumer evaluation and choice.

Limitations and Future Research

The present research was not without limitations. We provided an analytical account and experimental support of consumer choice behavior and showed that a perception of progress mediates the effect of path characteristics on choice. However, an investigation of the psychological antecedents of this perception was beyond the scope of the present paper. Based on prior research, the underlying process may be purely affective, with consumers experiencing annoyance and

[6] One of Murphy's laws is "the other line (queue) always move faster." People probably choose the queue in which consumers seem to be making more progress, only to find out that this perceived progress was virtual and that other queues were just as good, or perhaps even better.

frustration during idle times or periods of negative displacement (Larson 1987). Alternately, the underlying process may be perceptual, with the presence of idle time and negative displacement increasing the perceived elapsed time (Osuna 1985). Future research could investigate such psychological antecedents in more detail.

Second, we note that the present research is an account of consumer choice made prior to entering the service situation, and we argue that this choice is based on the predicted utility as assessed at the time of making the choice. Prior research in the area of sequences and experiences over time has tended to study retrospective effects. Some of our results seem inconsistent with this prior research at first blush. For instance, Carmon and Kahneman (1996) report that retrospective evaluation is significantly lowered when idle occurs towards the end of a service, while our model and results show that late idle is not as damaging as early idle. One question of interest, therefore, is whether the predicted utility actually captures how consumers feel during the course of the service, and at its conclusion. We demonstrate elsewhere (Soman 2003) that obstacles (like idle and negative displacement) also affect the retrospective evaluation in the same manner as they affect choice. However, while late obstacles are better than early obstacles for anticipated value and choice likelihood (as we showed here), late obstacles reduce retrospective evaluations significantly more than early obstacles (Carmon and Kahneman 1996, Soman 2003). These results seem to suggest that due to low predicted utility, consumers may not choose services that they would have retrospectively evaluated highly.

Third, we manipulated the perception of progress by holding the goal constant (reaching the destination state without concern for intermediate states) but changing the path characteristics. An alternative approach would be to not only manipulate path characteristics, but also the goal. For example, suppose the consumer's goal was not only to reach the final destination but also to get some work done on the train. We speculate that path characteristics would have less of an effect on choice behavior in this situation. While this approach was beyond the scope of our present investigation, it provides a fruitful avenue for future research to explore.

Fourth, we did not study learning effects, specifically whether the effects of virtual progress weaken with expertise and experience. While we do not have answers to these questions and leave the issue for future research, we would like to offer some speculations. First, it is likely that extremely frequent users of goal-oriented services quickly realize the "nonoptimality" of using virtual progress in their decision making and, hence, quickly converge towards an elapsed-time-only model. Examples of such consumers are daily users of the subway trains in large cities like Hong Kong, where a number of possible paths are available to travel between certain central locations. However, consumers in infrequent commuting situations (e.g., flights) might still be susceptible to the effects of virtual progress. Second, expert consumers are likely to use a decision-making strategy in which they anticipate how they would feel at the conclusion of the service (Shiv and Huber 2000). As we discussed earlier, this concluding evaluation will be influenced more by late obstacles than early ones. Hence, to the extent that consumers weight their anticipated satisfaction in making choice decisions, we expect that the effects of time discounting in our model will be weakened. However, we would still expect a preference for paths without idle or negative displacement.

Fifth, while we conducted our experiments in three separate domains, we acknowledge that the medical treatments domain might not have offered a very clean test of the effects of virtual progress, and that alternative explanations might have contributed to the results in the domain. For example, it is conceivable that even when subjects were told that a blood sugar level of 224 was acceptable, a risk-averse individual would choose to avoid being so "close to the boundary." Additionally, some medical treatment situations might also represent situations in which intermediate progress might provide some diagnostic information to both the consumer and physician, and hence is not purely virtual (cf. Orlando 1998). Our objective was not to claim that these factors play no role and that virtual progress is the only determinant of the results. Instead, by using the best levels of control we could exercise in the medical treatment domain in conjunction with the results from other domains, we simply wanted to demonstrate the breadth of the virtual progress effect. Healthcare is an area where we speculate that intermediate progress is important for several reasons, and it presents an intriguing avenue for future research to explore.

Finally, one interesting extension of this research relates to the study of how consumers structure tasks that have a fixed total quantity but are comprised of a number of parts of varying sizes. Our theoretical development suggests that consumers may like to structure the task in such a manner as to achieve early perception of progress. Consequently, they may prefer to get a larger number of easier tasks done early and leave the longer ones for the end. Other routine decisions and evaluations like decisions to take a break, renege from a task, speed up performance, or refresh and restart the effort are all related to perceptions of progress and represent fruitful avenues for future research.

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